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STANDARDS FOR THE BASAL METABOLISM OF CHILDREN FROM 2 TO 15 YEARS OF AGE, INCLUSIVE

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A RECENT report by Lewis, Duval, and Iliff[1] has demonstrated that the mean values for the basal metabolism of normal children from 2 to 12 years of age, inclusive, reported by Lewis, Kinsman, and Iliff,[2] in 1937, do not differ significantly in the main from those which have been obtained more recently. These old and new data have been combined for statistical analysis with those included in the report of Lewis, Duval, and Iliff[3] on the basal metabolism of normal children from 13 to 15 years of age, inclusive. On the basis of this analysis of the results of 1,007 basal metabolism determinations on seventy boys and 718 basal metabolism determinations on fifty-seven girls, standards for children from 2 to 15 years of age, inclusive, have been established and are herein reported.

PROCEDURE FOR COMPUTATION OF STANDARDS

The same class intervals have been used in grouping the whole data as were used for the values on children from 2 to 12 years of age, inclusive. Those values referred to age have been grouped in yearly intervals; those referred to weight, in intervals of 2 kg.; those referred to height, in 6 cm. intervals; and those referred to surface area, in intervals of 0.07 square meter. The mean, the standard deviation from the mean, their respective standard errors, and the coefficient of variation for each group have then been computed by the formulas used by Lewis, Kinsman, and Iliff.[2] Space does not permit the detailed presentation of the results of this analysis, but the complete data may be found

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This report is taken from the dissertation submitted by Anna Marie Duval to the Faculty of the Graduate School of the University of Colorado, June 1942, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

elsewhere.* The degree of dispersion about the mean may be judged from Table I which gives the mean values of the coefficient of variation as computed for each method of reference for both boys and girls. It may be seen that the lowest degree of scatter is evidenced for calories per hour referred to weight and surface area, respectively, and for calories per hour per square meter referred to age. An intermediate degree of dispersion is found for calories per hour per centimeter referred to age and for calories per hour referred to height, while the greatest dispersion is shown when calories per hour and calories per hour per kilogram, respectively, are referred to age. This order of degree of dispersion is the same as that found by Lewis, Kinsman, and Iliff.[2]

TABLE I

THE MEAN COEFFICIENTS OF VARIATION RESULTING FROM THE STATISTICAL ANALYSIS OF 1,037 BASAL METABOLISM DETERMINATIONS ON SEVENTY BOYS AND 718 BASAL METABOLISM DETERMINATIONS ON FIFTY-SEVEN GIRLS BETWEEN THE AGES OF 2 AND 15 YEARS, INCLUSIVE

METHOD OF REFERENCE	COEFFICIENT OF VARIATION (PER CENT)	
	BOYS	GIRLS
Calories per hour referred to weight	5.9	6.0
Calories per hour referred to surface area	6.2	6.2
Calories per hour per square meter referred to age	6.3	5.7
Calories per hour per centimeter referred to age	7.0	7.1
Calories per hour referred to height	7.3	7.1
Calories per hour referred to age	8.7	9.2
Calories per hour per kilogram referred to age	8.8	9.7

For graphic presentation of the complete data, calories per hour per square meter referred to age and calories per hour referred to weight, height, and surface area, respectively, have been chosen as the methods of reference. The selection of calories per hour per square meter referred to age and calories per hour referred to weight and surface area, respectively, has been made on the basis of the low degree of scatter exhibited, while the selection of calories per hour referred to height, even though it shows an intermediate degree of dispersion, has been made because of its wide use in the literature. Scatter diagrams of the results, expressed in these four ways, for all satisfactory determinations on boys and girls from 2 to 15 years of age, inclusive, obtained in this laboratory up to Jan. 15, 1941, are presented in Figs. 1 to 8, inclusive. The solid lines which are used to indicate the trends of the mean values have been fitted by inspection. For calories per hour referred to weight (Figs. 3 and 4), no values on boys weighing more than 49.9 kg. or on girls weighing more than 45.9 kg. have been considered because of the scarcity of data beyond these points. For the same reason,

*The results of the statistical analysis of these data may be found in Tables I to VII, inclusive, Part III of the dissertation of Anna Marie Duval, "A Study of the Basal Metabolism of Normal Children from Two to Fifteen Years Old, Inclusive," which is on permanent deposit in the Charles Denison, M.D., Memorial Library, University of Colorado School of Medicine, Denver. Microfilm copy of these tables (pp. 162-168, inc.) may be obtained from the Librarian, University of Colorado, Boulder, Colo.

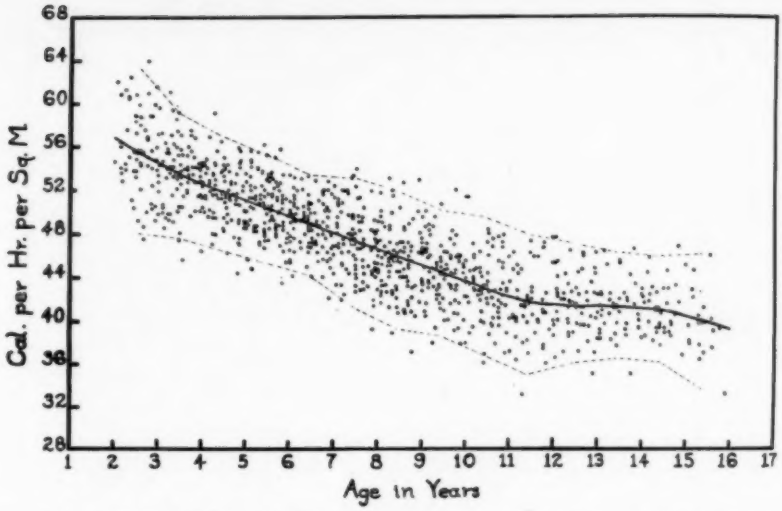

Fig. 1.—Scatter diagram of the results of 1,007 basal metabolism determinations on seventy normal boys expressed as calories per hour per square meter of body surface referred to age. A dot enclosed by a square indicates the weighted mean for the age panel. The solid line indicating the general trend of the mean values has been fitted by inspection. The region between the broken lines is that included within plus and minus two standard deviations from the means.

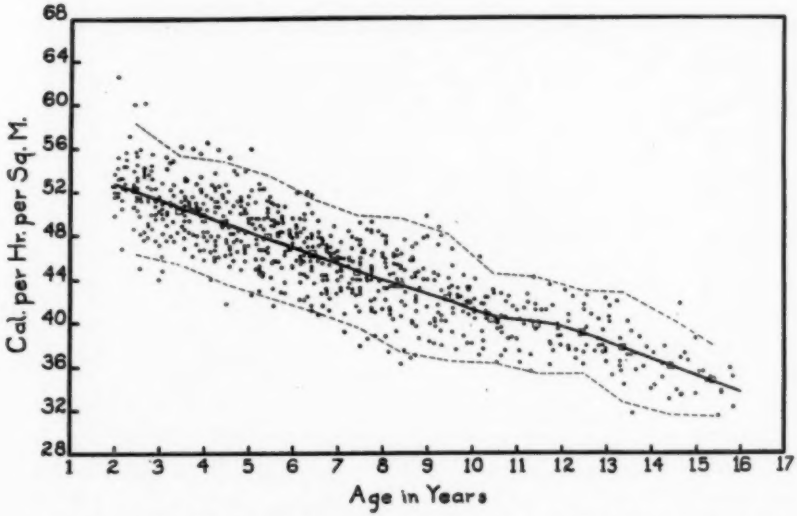

Fig. 2.—Scatter diagram of the results of 718 basal metabolism determinations on fifty-seven normal girls expressed as calories per hour per square meter of body surface referred to age. A dot enclosed by a square indicates the weighted mean for the age panel. The solid line indicating the general trend of the mean values has been fitted by inspection. The region between the broken lines is that included within plus and minus two standard deviations from the means.

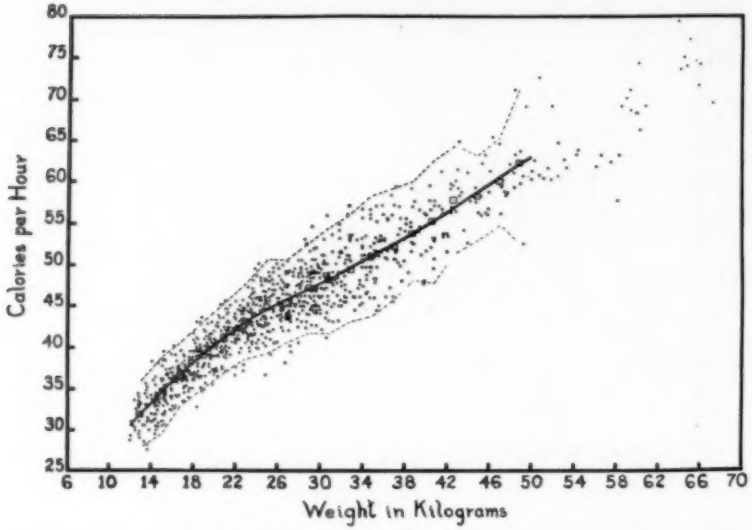

Fig. 3.—Scatter diagram of the results of 1,007 basal metabolism determinations on seventy normal boys expressed as calories per hour referred to weight. The solid line indicating the general trend of the mean values has been fitted by inspection from the weighted means (dot enclosed by a square). The region between the broken lines is that included within plus and minus two standard deviations from the means.

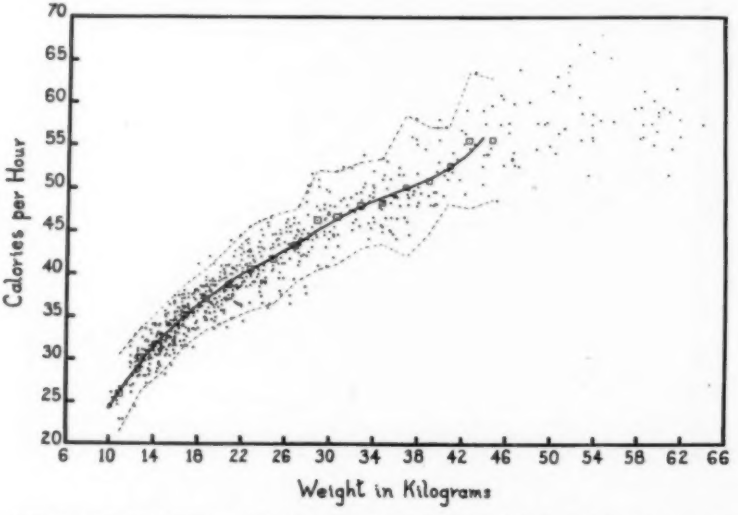

Fig. 4.—Scatter diagram of the results of 718 basal metabolism determinations on fifty-seven normal girls expressed as calories per hour referred to weight. The solid line indicating the general trend of the mean values has been fitted by inspection from the weighted means (dot enclosed by a square). The region between the broken lines is that included within plus and minus two standard deviations from the means.

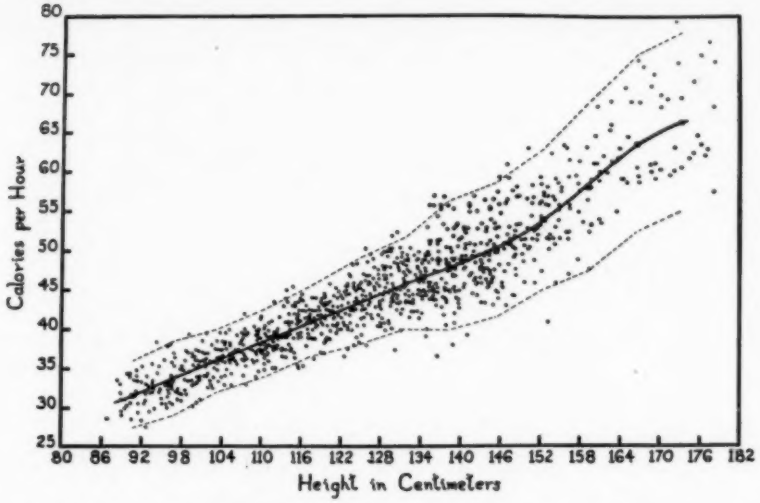

Fig. 5.—Scatter diagram of the results of 1,007 basal metabolism determinations on seventy normal boys expressed as calories per hour referred to height. The solid line indicating the general trend of the mean values has been fitted by inspection from the weighted means (dot enclosed by a square). The region between the broken lines is that included within plus and minus two standard deviations from the means.

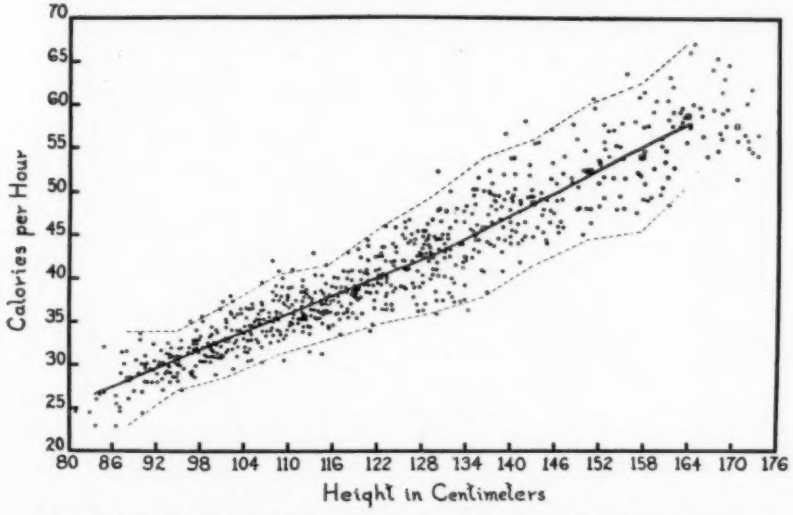

Fig. 6.—Scatter diagram of the results of 718 basal metabolism determinations on fifty-seven normal girls expressed as calories per hour referred to height. The solid line indicating the general trend of the mean values has been fitted by inspection from the weighted means (dot enclosed by a square). The region between the broken lines is that included within plus and minus two standard deviations from the means.

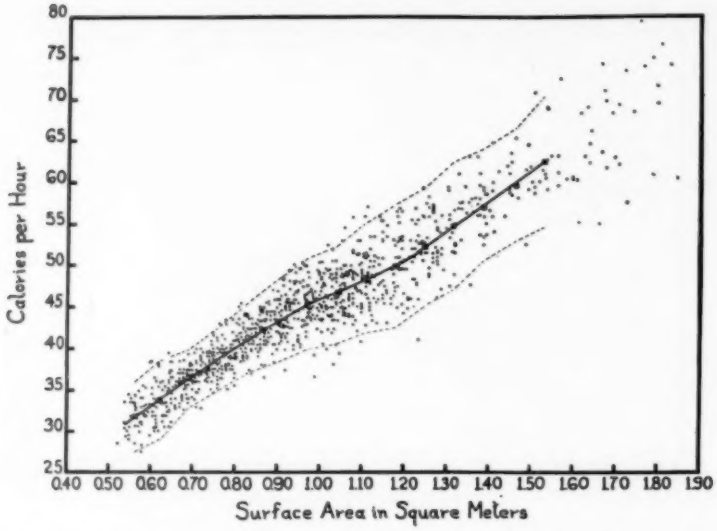

Fig. 7.—Scatter diagram of the results of 1,007 basal metabolism determinations on seventy normal boys expressed as calories per hour referred to surface area. The solid line indicating the general trend of the mean values has been fitted by inspection from the weighted means (dot enclosed by a square). The region between the broken lines is that included within plus and minus two standard deviations from the means.

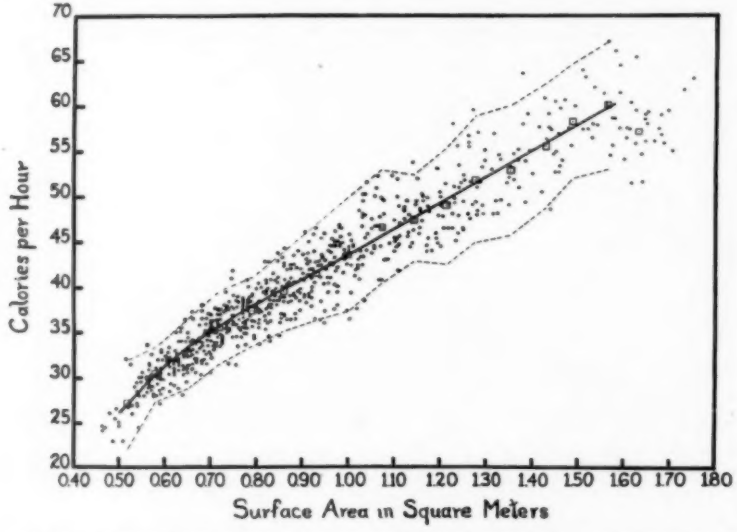

Fig. 8.—Scatter diagram of the results of 718 basal metabolism determinations on fifty-seven normal girls expressed as calories per hour referred to surface area. The solid line indicating the general trend of the mean values has been fitted by inspection from the weighted means (dot enclosed by a square). The region between the broken lines is that included within plus and minus two standard deviations from the means.

the central trend line of the means for calories per hour referred to height for boys (Fig. 5) has not included the few determinations on boys taller than 176.9 cm., while that for girls (Fig. 6) has been established exclusive of the last mean because of the small number of different girls represented in this panel. In establishing the central trend line of the means for calories per hour referred to surface area for boys (Fig. 7), the determinations on boys larger than 1.569 square meters have not been included because of the scattered nature of these data, while that for girls (Fig. 8) has been discontinued at 1.580 square meters, because the trend beyond this point is indeterminate. The values for plus and minus two standard deviations from the mean of each group are indicated by the broken lines on each figure. By all methods of reference shown in these figures, boys have been found to give higher values than girls.

In order to prepare tables of standards for the basal metabolism of boys and girls from 2 to 15 years of age, inclusive, values for desired class intervals in the case of each method of reference have been taken from Figs. 1 to 8 inclusive. These standards for calories per hour

TABLE II

STANDARD VALUES FOR CALORIES PER HOUR PER SQUARE METER REFERRED TO AGE FOR BOYS AND GIRLS FROM 2 TO 15 YEARS OF AGE, INCLUSIVE

AGE (YEARS)	CALORIES PER HOUR PER SQUARE METER		AGE (YEARS)	CALORIES PER HOUR PER SQUARE METER	
	BOYS	GIRLS		BOYS	GIRLS
2.00	56.9	52.9	9.00	45.0	42.7
2.25	56.2	52.4	9.25	44.6	42.4
2.50	55.6	52.0	9.50	44.3	42.1
2.75	55.0	51.6	9.75	44.0	41.7
3.00	54.5	51.3	10.00	43.6	41.4
3.25	53.9	50.9	10.25	43.2	41.1
3.50	53.4	50.6	10.50	42.8	40.8
3.75	53.0	50.2	10.75	42.5	40.6
4.00	52.6	49.9	11.00	42.2	40.4
4.25	52.2	49.5	11.25	41.9	40.3
4.50	51.8	49.1	11.50	41.7	40.2
4.75	51.4	48.7	11.75	41.6	39.9
5.00	51.0	48.4	12.00	41.5	39.7
5.25	50.6	48.0	12.25	41.5	39.4
5.50	50.3	47.6	12.50	41.4	39.1
5.75	50.0	47.2	12.75	41.4	38.7
6.00	49.6	46.9	13.00	41.4	38.4
6.25	49.2	46.5	13.25	41.3	38.0
6.50	48.9	46.2	13.50	41.2	37.6
6.75	48.6	45.8	13.75	41.2	37.2
7.00	48.2	45.5	14.00	41.1	36.8
7.25	47.8	45.1	14.25	41.0	36.4
7.50	47.4	44.7	14.50	40.9	36.0
7.75	47.0	44.3	14.75	40.7	35.6
8.00	46.6	44.0	15.00	40.5	35.2
8.25	46.2	43.6	15.25	40.2	34.8
8.50	45.8	43.3	15.50	39.8	34.5
8.75	45.4	43.0	15.75	39.5	34.1

TABLE III

STANDARD VALUES FOR CALORIES PER HOUR REFERRED TO WEIGHT FOR BOYS AND GIRLS

WEIGHT (KG.)	CALORIES PER HOUR		WEIGHT (KG.)	CALORIES PER HOUR	
	BOYS	GIRLS		BOYS	GIRLS
10.0		24.3	30.0	47.6	45.8
11.0		26.2	31.0	48.3	46.7
12.0	30.5	28.0	32.0	49.0	47.3
13.0	31.9	29.8	33.0	49.6	48.0
14.0	33.2	31.2	34.0	50.3	48.5
15.0	34.5	32.7	35.0	51.0	49.0
16.0	35.7	34.0	36.0	51.7	49.5
17.0	37.0	35.2	37.0	52.4	50.0
18.0	38.2	36.1	38.0	53.1	50.5
19.0	39.2	37.2	39.0	53.9	51.0
20.0	40.2	38.0	40.0	54.6	51.7
21.0	41.2	39.0	41.0	55.4	52.5
22.0	42.1	39.8	42.0	56.2	53.5
23.0	43.0	40.5	43.0	57.0	54.6
24.0	43.8	41.2	44.0	57.8	56.0
25.0	44.5	42.0	45.0	58.6	
26.0	45.2	42.7	46.0	59.4	
27.0	45.8	43.5	47.0	60.3	
28.0	46.4	44.4	48.0	61.2	
29.0	47.0	45.2	49.0	62.0	
			50.0	62.8	

TABLE IV

STANDARD VALUES FOR CALORIES PER HOUR REFERRED TO HEIGHT FOR BOYS AND GIRLS

HEIGHT (CM.)	CALORIES PER HOUR		HEIGHT (CM.)	CALORIES PER HOUR	
	BOYS	GIRLS		BOYS	GIRLS
84		26.8	130	45.3	43.0
86		27.5	132	46.0	43.8
88	30.7	28.2	134	46.6	44.6
90	31.4	28.9	136	47.2	45.4
92	32.1	29.6	138	47.9	46.2
94	32.8	30.3	140	48.6	47.0
96	33.5	31.0	142	49.3	47.8
98	34.2	31.7	144	50.0	48.7
100	34.9	32.4	146	50.7	49.6
102	35.6	33.1	148	51.6	50.5
104	36.3	33.8	150	52.5	51.4
106	37.0	34.5	152	53.5	52.3
108	37.7	35.2	154	54.9	53.2
110	38.4	35.9	156	56.3	54.1
112	39.1	36.6	158	57.7	55.0
114	39.8	37.3	160	59.1	55.9
116	40.5	38.0	162	60.5	56.8
118	41.2	38.7	164	61.9	57.7
120	41.8	39.4	166	63.2	58.6
122	42.5	40.1	168	64.3	
124	43.2	40.8	170	65.3	
126	43.9	41.5	172	66.0	
128	44.6	42.2	174	66.6	

per square meter referred to age and for calories per hour referred to weight, height, and surface area, respectively, are presented in Tables II to V, inclusive. The reliability of these standards for the age range from 2 to 12 years of age, inclusive, has now been definitely established, since it has been shown[1] that the means reported for the portion of the

TABLE V

STANDARD VALUES FOR CALORIES PER HOUR REFERRED TO SURFACE AREA FOR BOYS AND GIRLS

SURFACE AREA (SQ. M.)	CALORIES PER HOUR		SURFACE AREA (SQ. M.)	CALORIES PER HOUR	
	BOYS	GIRLS		BOYS	GIRLS
0.500		26.2	1.060	47.1	45.2
0.520		27.0	1.080	47.6	45.8
0.540	30.8	28.1	1.100	48.1	46.4
0.560	31.6	29.5	1.120	48.5	47.0
0.580	32.4	30.4	1.140	49.0	47.6
0.600	33.1	31.3	1.160	49.5	48.2
0.620	33.8	32.2	1.180	50.0	48.8
0.640	34.5	33.0	1.200	50.4	49.4
0.660	35.2	33.8	1.220	51.0	49.9
0.680	35.9	34.5	1.240	51.7	50.5
0.700	36.6	35.2	1.260	52.5	51.1
0.720	37.3	35.8	1.280	53.3	51.6
0.740	38.0	36.4	1.300	54.1	52.2
0.760	38.7	37.0	1.320	54.8	52.7
0.780	39.4	37.6	1.340	55.5	53.3
0.800	40.1	38.2	1.360	56.2	53.9
0.820	40.7	38.8	1.380	56.9	54.5
0.840	41.3	39.4	1.400	57.6	55.1
0.860	42.0	39.9	1.420	58.3	55.6
0.880	42.6	40.4	1.440	59.0	56.2
0.900	43.2	40.9	1.460	59.7	56.8
0.920	43.8	41.4	1.480	60.4	57.4
0.940	44.4	41.9	1.500	61.1	57.9
0.960	45.0	42.4	1.520	61.8	58.5
0.980	45.5	42.9	1.540	62.5	59.1
1.000	46.0	43.4	1.560		59.7
1.020	46.3	44.0	1.580		60.3
1.040	46.7	44.6			

data obtained more recently in this age range do not differ significantly from those published earlier.[2] Further work is being done to test the validity of these standards on older children.

COMPARISON WITH OTHER STUDIES

A desirable aid in the evaluation of any set of standards is their comparison with results already reported in the literature. In previous publications[1-3] comparisons have already been made between values for basal metabolism obtained in this laboratory and the data reported in the literature by other workers. These are supplemented here by graphic comparison of the standard values herein reported and those of certain comprehensive reports in the literature. The latter have been chosen because they represent extensive longitudinal studies or because they include data on a large number of different children.

Fig. 9 depicts the standard curve for calories per hour per square meter for the boys of this study and those of Boothby, Berkson, and Dunn,[4] Webster, Harrington, and Wright,[5] Bierring,[6] and Miana-Calabrese,[7] who has analyzed the data of Pepe and Rinaldi[8] and Pepe and Perrelli.[9] The age range in this chart is limited to that from 6 to 15 years, inclusive, because none of the studies except the present one has included data on younger children. It may be seen that the values

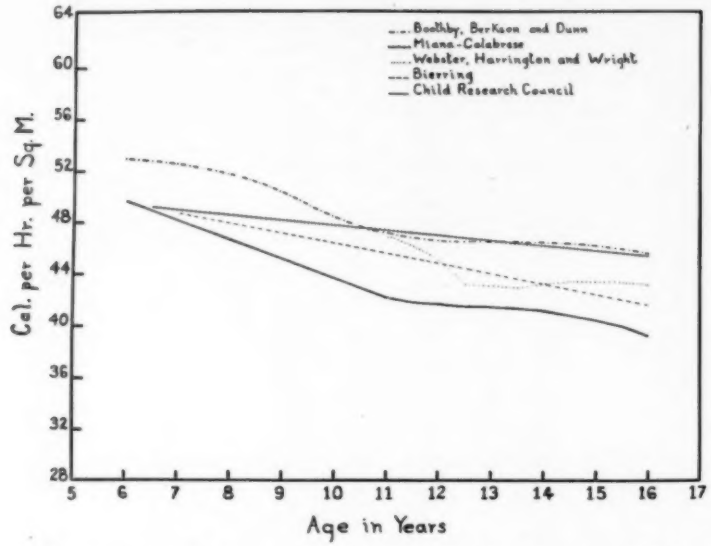

Fig. 9.—Comparison of the basal metabolism values for boys reported by the workers indicated on the figure expressed as calories per hour per square meter referred to age.

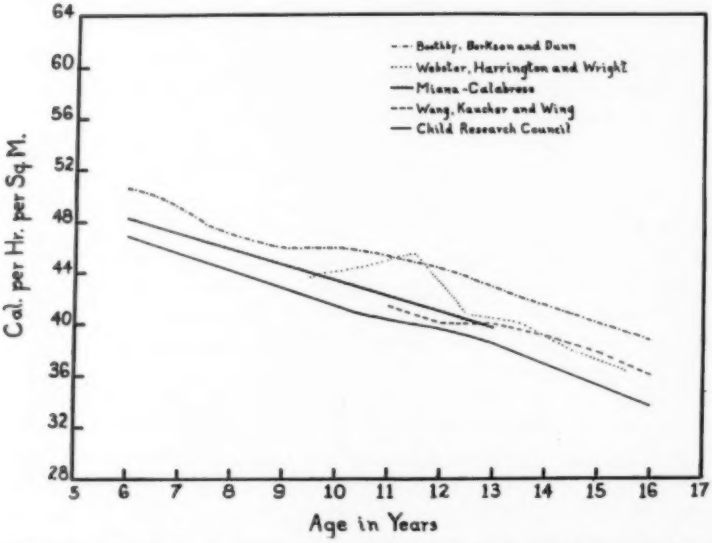

Fig. 10.—Comparison of the basal metabolism values for girls reported by the workers indicated on the figure expressed as calories per hour per square meter referred to age.

from this laboratory are lower than those of the other workers, but they approach the results of Bierring and of Miana-Calabrese for the younger boys. The general trend of the results of Boothby, Berkson, and Dunn is quite similar to that of the present study, but the level of their results is markedly higher. Close agreement is to be found between the results on the older boys of these latter investigators and those reported by Miana-Calabrese, whereas the results of Bierring and Webster, Harrington, and Wright occupy, for the most part, an intermediate position on the figure.

Fig. 10 presents a comparison between the standard curve for calories per hour per square meter referred to age for the girls of this study and those of Boothby, Berkson, and Dunn,[4] Webster, Harrington, and Wright,[5] Wang, Kaucher, and Wing,[10] and Miana-Calabrese,[7] who has analyzed the data of Pepe and Rinaldi[8] and Pepe and Perrelli.[9] The general trend of the results of Boothby, Berkson, and Dunn parallels that of the present study, but their values lie at a higher level. The Child Research Council values are more nearly approached by, but are definitely lower than, those of Miana-Calabrese for the younger girls and those of Wang, Kaucher, and Wing and Webster, Harrington, and Wright for the older girls. The peak seen in the curve of the latter study is probably due to the smaller number of observations made at that age than on older girls.

In Fig. 11 the comparison is made between the values for calories per hour referred to weight for the boys of this study and the comparable results reported by Bierring,[6] de Bruin,[11] in 1939, and Talbot,[12] in 1938. In the range from 13 to 26 kg. the values of de Bruin and Bierring check those of the present study very closely. Thereafter, the values from this laboratory lie at a lower level until a weight of 43 kg. is reached, when they are once more approached by the results of de Bruin. The results of Talbot are lower than those of the other studies in the range from 13 to 30 kg., but they approximate those from this laboratory thereafter.

A comparison between the values of the present study for calories per hour referred to weight for girls and the comparable results reported by de Bruin,[11] in 1939, and Talbot, Wilson, and Worcester,[13] in 1937, is presented in Fig. 12. The values from this laboratory occupy an intermediate position between those of the other two studies, but for the smaller girls the results are close to those of de Bruin and for the larger girls they approximate those of Talbot, Wilson, and Worcester.

In Fig. 13 the values for the basal metabolism of boys are expressed as calories per hour referred to height. The results of Bierring[6] and those reported by Talbot,[12] in 1938, are represented in comparison with those of the present study. The slope of the curve for the data of Bierring is greater than that from this laboratory, with the result that his values are lower for boys shorter than 128 cm. but higher for the taller boys. A similar tendency to intersect the curve of the results

of the Child Research Council is seen in the data of Talbot, but that the transition from lower to higher values occurs at 140 cm.

Fig. 14 presents a comparison between the standard values of this report for calories per hour referred to height for girls and the comparable results of Talbot, Wilson, and Worcester.[13] The values of the latter study are lower than those from this laboratory for girls shorter than 140 cm. but higher for the taller girls.

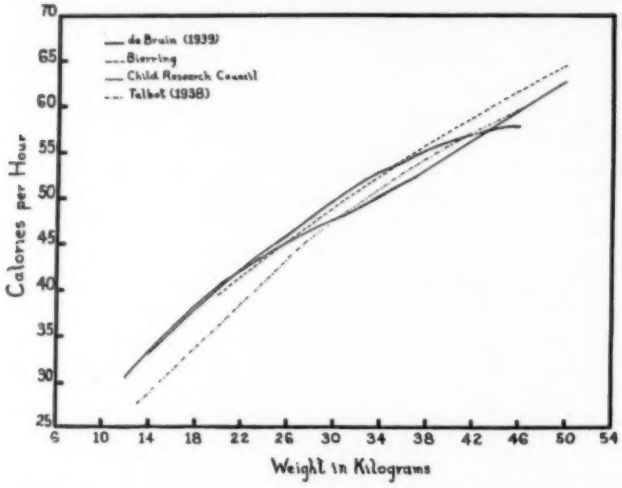

Fig. 11.—Comparison of the basal metabolism standards for boys reported by the workers indicated on the figure expressed as calories per hour referred to weight.

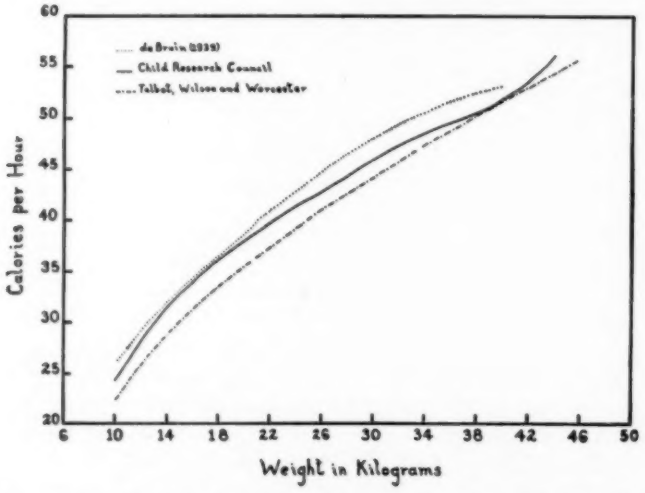

Fig. 12.—Comparison of the basal metabolism standards for girls reported by the workers indicated on the figure expressed as calories per hour referred to weight.

It would be superfluous to attempt graphic comparison of the values of this report for calories per hour referred to surface area with others in the literature, since the publication of Lewis, Kinsman, and Iliff,[2] in 1937, has already thus presented the only data suitable for such expression. It was shown therein that the results reported by Bierring[6]

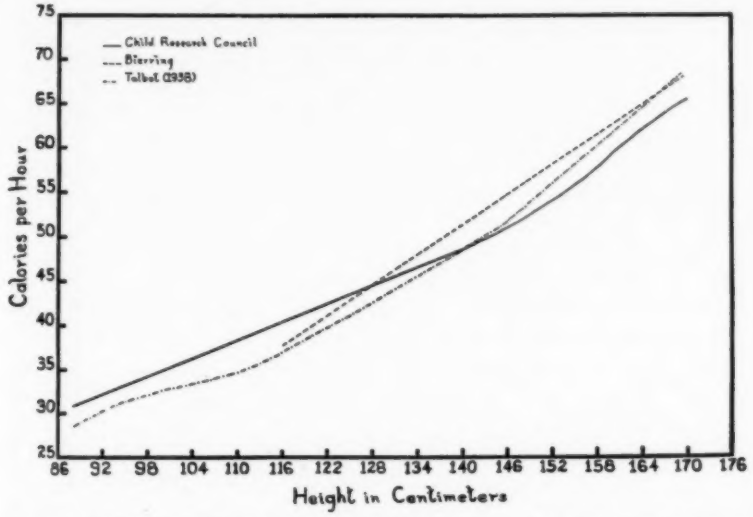

Fig. 13.—Comparison of the basal metabolism standards for boys reported by the workers indicated on the figure expressed as calories per hour referred to height.

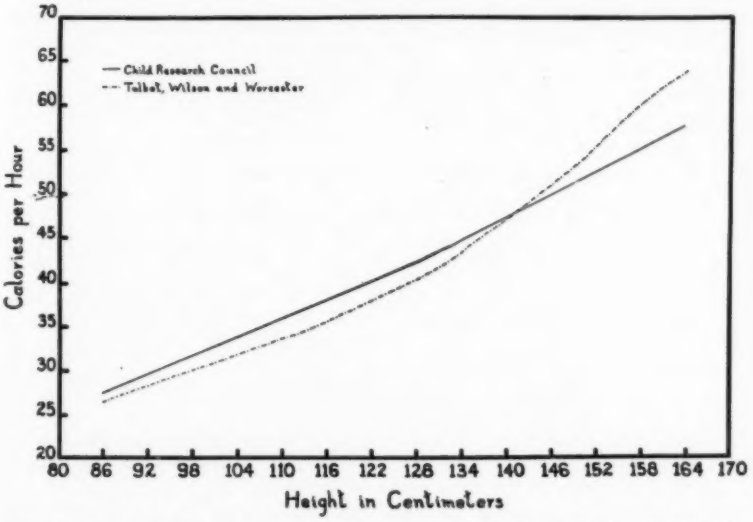

Fig. 14.—Comparison of the basal metabolism standards for girls reported by the workers indicated on the figure expressed as calories per hour referred to height.

for boys and de Bruin,[14] in 1933, for boys and girls were quite comparable to those for the children of the Child Research Council. This relationship remains essentially unchanged as a result of the extension of the data from this laboratory.

GENERAL APPLICABILITY OF THE STANDARDS PRESENTED

Following the preliminary publication of Lewis, Kinsman, and Iliff,[2] in 1937, certain questions arose with regard to the general applicability of the standards for basal metabolism presented in that report. The suggestion was made that basal metabolism might vary with altitude, and, if this were true, standards established in Denver at an altitude of 5,280 feet above sea level would be of limited value for general use. This question has been answered by Lewis, Iliff, Duval, and Kinsman[15] and Lewis, Iliff, and Duval[16] who have shown that, at least for elevations under 9,000 feet, the basal metabolism is not affected by altitude. Thus, the standards for the basal metabolism of children obtained at an altitude of 5,280 feet may be considered reliable for use at altitudes within the range from sea level to an elevation of 9,000 feet.

The second question raised was whether standards established with the open circuit method used in this laboratory could be applied when the basal metabolism was determined by the closed circuit method used by most clinicians. The fact that no direct comparison of the two methods could be found in the literature led Lewis, Iliff, and Duval[17] to make such a study. They found that comparable values for basal metabolism can be obtained on the same child when both the open and closed circuit procedures are used in close succession on the same day. When extreme care is taken to have the subject in a postabsorptive condition, well relaxed, and with muscular activity cut to a minimum, the observation of careful technique will ensure determinations that will be a true measure of the basal metabolism regardless of which type of apparatus is used.

CHOICE OF METHODS OF REFERENCE FOR EVALUATING BASAL METABOLISM

A critical survey of the literature reveals marked differences of opinion with regard to the choice of methods of reference for basal metabolism. While low dispersion about the mean seems to be the best criterion for the selection of methods to be used for expressing the basal metabolism, it must not be forgotten that a method which shows relatively great dispersion may be useful for a longitudinal study of an individual child in relation to other physiologic variations which he may exhibit. In the clinical use of standards of basal metabolism, interpretations of results must be made on the basis of the deviation of the values on any individual child from those established for the standard group of children. Use of the method of reference showing the lowest degree of dispersion gives the clearest picture of the deviation of that child from the standard. However, if the results of basal metabolism determinations are not being considered solely to judge deviation

from the standard values, informative relationships may be established by comparison of other physiologic functions and physical traits with the basal metabolism expressed by the several methods of reference irrespective of their relative degree of dispersion. Thus, the choice of methods of reference for the establishment of standards of basal metabolism on the basis of the degree of dispersion about the mean renders those standards most useful for application in clinical practice, but the use of more variable methods of reference may serve a useful purpose in the study of physiologic relationships in children.

When the degree of dispersion about the mean is taken as the criterion of selection, the coefficient of variation may be used to compute the percentage deviation from the mean to be expected in normal individuals. The value for plus and minus two times the coefficient of variation will set the range for 95 per cent of a normal population, while plus and minus three times the coefficient of variation will include 99.7 per cent of normal individuals. Using the mean values for the coefficient of variation given in Table I, it will be found that 95 per cent of healthy children fall within ±12 per cent of the standard when calories per hour referred to weight and surface area, respectively, and calories per hour per square meter referred to age are used as the methods of reference, while 99.7 per cent of normal children are included within ±18 per cent of these standards. The comparable values for calories per hour referred to height are ±15 per cent and ±22 per cent, respectively, for boys and ±14 per cent and ±21 per cent, respectively, for girls. Thus, it is seen that the use of calories per hour referred to height as a measure of the metabolism gives a higher variation than the other three methods. However, this difference is not sufficiently great to bar the use of this method of reference in the evaluation of basal metabolism.

The above considerations on the choice of methods of reference for basal metabolism are based on the variation around the mean for a large group of individuals. When the basal metabolism of any individual child is to be evaluated, the factor of the body size of that child must also be taken into account. Calculation of the percentage deviations from the standard by all four methods of reference in the case of almost any individual child will reveal certain more or less marked discrepancies. These are evidently dependent upon the position of that child in height, weight, and surface area relative to the group as a whole and upon the deviation in the weight to height relationship of that child from that of the hypothetical average child of the study upon which the standards are based. The closer any child comes to the mean values for height, weight, and surface area of the group with which the standards were established, the less marked will be the discrepancies by the different methods of reference. Accordingly, a clearer picture of the significance of deviation from the standard in any child may be obtained by comparison of the weight, height, and surface area of that child with the means of these measurements for

the standard group. In order that they may be available for such comparison, the maximum, minimum, and mean values for weight, height, and surface area referred to age for the children included in this report are given in Table VI for the boys and in Table VII for the girls.

The foregoing discussion of the importance of considering body size in evaluating the results of basal metabolism determinations may best be illustrated by a consideration of specific examples of results obtained by the several methods of reference on individuals of markedly varied body size. In Table VIII are presented the comparable data for weight, height, and surface area of three boys of approximately the same age but of different sizes; also the percentage deviations of the determined basal metabolism from the standards herein presented for the different methods of reference. Subject 1 gives almost identical values by the four methods of reference. Table VI reveals that his weight, height, and surface area are very close to the mean values for boys of his age. Marked discrepancies are noted for Subject 2 when the determined basal metabolism is evaluated by the several methods of reference. This child's weight, height, and surface area compare with the mean values for children from 3.5 to 4 years younger. As would be expected, the greatest deviation from normal occurs in this subject when age is taken into account, as it is in the use of calories per hour per square meter in relation to age. Subject 3 is larger than the average for boys of his age, as his height and weight compare closely to the average values for boys 2 and 4 years older, respectively. In his case only slight deviations from the standard occur when calories per hour per square meter are referred to age and calories per hour are referred to weight, but marked deviations occur when calories per hour are referred to surface area and height, respectively.

The above examples have been given merely to emphasize the important part played by relative body size in the proper interpretation of the basal metabolism of any individual child. If weight, height, and surface area fall close to the means of these measurements for the children of the standard group, it makes little difference which method of reference is used. However, when any one or all of these body measurements differ considerably from those of the hypothetical normal child of comparable age, the method of referring calories per hour per square meter to age will obviously be of little value. In such cases computation of the basal metabolism in terms of calories per hour referred to weight, height, and surface area, respectively, should be made, and the interpretation should then be based on the percentage deviation of all three of these measurements from the standard values. Elaboration of this discussion will be presented in a future report.

Little can be said at the present time with regard to the choice of standards for children of abnormal body proportions. In such cases the problem is one of much greater complexity, and its solution will

TABLE VI

MEAN, MAXIMUM, AND MINIMUM VALUES FOR THE WEIGHT, HEIGHT, AND SURFACE AREA (DU BOIS AND DU BOIS[18] HEIGHT-WEIGHT FORMULA WITH CONSTANT 71.84) FOR BOYS OF THE PRESENT STUDY

AGE (YR.)	WEIGHT (KG.)			HEIGHT (CM.)			SURFACE AREA (SQ. M.)		
	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM	MINIMUM
2 to 3	13.7	16.4	12.0	93.0	98.5	86.9	0.584	0.645	0.525
3 to 4	15.7	19.4	12.9	100.1	107.3	93.7	0.653	0.750	0.590
4 to 5	17.7	22.2	14.5	107.7	119.4	101.0	0.724	0.860	0.640
5 to 6	19.8	24.7	15.9	114.5	128.3	105.7	0.794	0.945	0.690
6 to 7	22.6	29.6	16.7	121.6	134.2	113.0	0.875	1.040	0.730
7 to 8	25.4	34.8	18.3	127.6	136.8	116.2	0.950	1.150	0.800
8 to 9	28.0	40.8	20.5	132.8	143.8	119.4	1.019	1.275	0.855
9 to 10	30.1	45.2	22.3	137.1	148.5	125.3	1.077	1.360	0.900
10 to 11	32.5	45.7	23.9	141.6	152.4	128.5	1.140	1.390	0.950
11 to 12	35.6	54.4	25.9	146.8	159.0	133.3	1.216	1.550	1.010
12 to 13	39.0	60.2	28.3	151.4	170.1	137.3	1.293	1.695	1.080
13 to 14	44.0	64.3	31.3	156.6	176.2	142.5	1.392	1.790	1.155
14 to 15	48.5	67.2	37.4	163.9	178.2	146.9	1.503	1.830	1.270
15 to 16	53.0	65.9	45.0	170.3	178.0	154.7	1.607	1.800	1.395

TABLE VII

MEAN, MAXIMUM, AND MINIMUM VALUES FOR THE WEIGHT, HEIGHT, AND SURFACE AREA (DU BOIS AND DU BOIS[18] HEIGHT-WEIGHT FORMULA WITH CONSTANT 71.84) FOR GIRLS OF THE PRESENT STUDY

AGE (YR.)	WEIGHT (KG.)			HEIGHT (CM.)			SURFACE AREA (SQ. M.)		
	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM	MINIMUM
2 to 3	13.0	15.5	10.1	92.0	100.9	81.0	0.566	0.640	0.465
3 to 4	15.2	17.8	12.0	100.5	109.8	93.4	0.647	0.735	0.545
4 to 5	17.3	20.8	12.6	107.4	118.7	98.8	0.715	0.830	0.595
5 to 6	19.6	24.7	14.2	114.4	125.3	104.1	0.788	0.915	0.645
6 to 7	21.9	29.8	15.5	120.7	131.5	110.8	0.860	1.030	0.715
7 to 8	24.9	34.1	16.9	127.6	139.0	116.4	0.943	1.150	0.750
8 to 9	28.5	42.1	17.5	133.0	145.4	119.3	1.029	1.280	0.805
9 to 10	32.1	44.4	19.5	139.0	153.7	126.1	1.119	1.350	0.845
10 to 11	34.7	43.3	21.2	144.5	155.7	130.1	1.190	1.380	0.895
11 to 12	40.2	50.7	27.2	151.7	164.2	136.2	1.310	1.515	1.025
12 to 13	43.4	54.7	30.4	155.4	168.5	141.3	1.376	1.555	1.110
13 to 14	49.5	59.6	35.5	161.5	170.7	148.3	1.499	1.650	1.230
14 to 15	54.8	64.1	39.7	164.2	171.9	155.3	1.583	1.685	1.325
15 to 16	55.4	65.3	43.9	167.8	173.5	160.5	1.620	1.750	1.420

TABLE VIII

A COMPARISON OF METHODS OF REFERENCE FOR EXPRESSING BASAL METABOLISM (AS APPLIED TO THREE BOYS OF COMPARABLE AGE BUT MARKEDLY DIFFERENT SIZES)

SUBJECT	AGE		WEIGHT (KG.)	HEIGHT (CM.)	SURFACE AREA (SQ. M.)	PERCENTAGE DEVIATION FROM STANDARD			
	YR.	MO.				CALORIES PER HOUR PER SQUARE METER—AGE	CALORIES PER HOUR—SURFACE AREA	CALORIES PER HOUR—WEIGHT	CALORIES PER HOUR—HEIGHT
1	8	9	29.4	135.9	1.055	−7	−6	−6	−6
2	8	8	17.8	112.9	0.750	+14	+1	+2	−2
3	8	8	39.9	141.2	1.245	−1	+8	+2	+14

come only with a study of a large group of individuals of disproportionate body build.

SUMMARY

Standards for the basal metabolism of children from 2 to 15 years old, inclusive, have been established on the basis of 1,007 determinations on seventy normal, healthy boys and 718 determinations on fifty-seven normal, healthy girls.

The methods of reference selected for the establishment of these standards are calories per hour per square meter referred to age and calories per hour referred to surface area, weight, and height, respectively. The first three methods have been chosen because of the relatively low degree of dispersion exhibited, and the latter is included because it has found wide use in the literature.

Scatter diagrams constructed from the respective data are presented. The means for certain convenient arbitrary intervals, as well as the values for plus and minus two standard deviations from the mean, are indicated on these figures. The standards recorded in the tables are taken from the unbroken line curves drawn by inspection in each case to connect these means.

A comparison between the standards herein reported and the results of certain studies of basal metabolism chosen from the literature because of their comprehensive nature is included.

The importance of taking body size into consideration in the selection of standards to be used for the interpretation of the basal metabolism of any individual child is discussed.

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BASAL METABOLISM IN RHEUMATIC CHILDREN

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THIS analysis of 154 basal metabolism tests performed on ninety-seven ambulant rheumatic children was made to shed further light on the possible effect of rheumatic "toxin" upon the thyroid gland.

There seem to be no reported statistics on basal metabolism tests in rheumatic children, although low values in arthritis have been recorded by several observers. Edström[1] states that lowered basal metabolic rates are secondary to the rheumatic lesion: Of 369 patients with chronic rheumatic infectious arthritis, 24 per cent showed subnormal values; 6 per cent, supernormal; and 70 per cent, normal. On the average the rate was below the normal. In a series of twenty-nine cases of patients with atrophic arthritis, Pemberton and Tompkins[2] find 20 per cent with a basal metabolism slightly below normal limits. Hall and Monroe[3] report rates below –10 in 50 per cent of cases of patients with hypertrophic arthritis. Without quoting statistics, several writers[4-12] mention low basal metabolism as usually accompanying arthritis. Some observers, on the other hand, report normal or even supernormal basal metabolic rates in patients with arthritis,[13, 14] especially during acute infection.

In other low-grade chronic illness probably secondary to chronic infection, a low rate is the usual finding.[15] Thus Stiles[16] reports an average rate of –8 in 166 persons, with 43 per cent showing a rate of –10 or less. A tendency toward low values is noted in chronic catarrhal otitis,[17] recurrent colds, and sinusitis.[18-20] Changes observed in the thyroid following various infections[21-24] may result in altered metabolism.

In our study, basal metabolic rates were determined by the Benedict* method on ninety-seven rheumatic children of both sexes and ages from 8 to 17 years, inclusive. Where subnormal metabolic rates were encountered, the test was usually repeated. Since seasonal variations in metabolism readings soon became apparent, for purposes of their analysis three arbitrary periods were set: July to December, inclusive; January to March, inclusive; and April to June, inclusive.

Associated observations were made for the following conditions: hair and skin (whether normal or dry in texture); cold, clammy perspiration of the hands sometimes noted in association with hypothyroidism;[25] fatigability; body build; capillary resistance; twitching;

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*The calculations were based on the height-weight (or surface area) standard of Boothby and Sandiford. Benedict apparatus was used.

and mental alertness. Correlation was sought between these factors and basal metabolism.

RESULTS

1. Of the ninety-seven children, forty-five showed one or more basal metabolic rates below –10 per cent and 9 had one or more tests below –20 per cent. Abnormally increased basal metabolisms were found in only 2 patients.

2. The average basal metabolism reading of the ninety-seven children was –7.6 per cent. The average of all readings (154) was –8.7 per cent. This latter figure is the result of repeated tests performed on those children with abnormally low readings.

3. In 33 children, in whom duplicate basal metabolisms were recorded during each of two or three seasons, the average basal metabolic rates in July-December was –7.6 per cent (23 patients); in January-March, –8.3 per cent (20 patients); and in April-June, –11.4 per cent (27 patients).

4. In these 33 children the seasonal trend was as follows:

Twenty-one showed a trend toward lower metabolism from July-December to January-March and still lower to April-June. Seven showed an opposite trend. In 5 the trend was variable.

5. In 14 children treated with thyroid extract, the metabolic rates rose in all following treatment. (The tests performed following treatment are not included in this survey.) The rise occurred despite the fact that treatment took place between January and June, the period of lower values in most of the untreated children.

6. Seasonal (spring and fall) variations in the condition of the *skin* were noted as follows:

In the *spring*, 19 of 66 children revealed dry skin; 47 showed normal texture. In 4 of the 19 the dryness was excessive and was accompanied by a papular hyperkeratosis on the lateral aspects of the arms. The papular hyperkeratosis was not seen in the fall. The basal metabolic rates of all four of these children were abnormally low (below –10 per cent). The relationship between dry skin and hypothyroidism is well known.

In the *fall* the condition of the skin was recorded in 55 children as follows: only 3 were dry and 52 normal.

Where notations were made on the same children in the spring and fall, the results were as follows: In 38 children the skin was normal in both seasons; in 2 the skin was dry in both seasons. Twelve children with dry skin in the spring showed a normal skin in the fall, while none with normal skin in the spring showed dryness in the fall. Thus a strong tendency was noted toward skin normalcy following the summer.

7. Regarding the condition of the hair in the spring, in 65 children the hair was dry in 31 and normal in 34. In the fall, among 60 children, the hair was dry in 12 and normal in 48.

Where notations were made on the same individuals, seven children showed dryness of the hair in both seasons; 31 were normal in both seasons. In 15, dry hair in the spring became normal in the fall, whereas only 3 normal in the spring had dry hair in the fall. Thus hair also showed a tendency to improve in the fall, but less consistently than the skin.

8. Analyzing the basal metabolic rates of those patients with dry skin and dry hair, no especial correlation was noted beyond the general trend, already mentioned, toward lowered basal metabolic rates in the spring and improvement in the fall.

9. By ages, yearly from age 8 to age 17, inclusive, no marked differences appeared in the basal metabolic rates.

10. No definite relationship could be established between basal metabolism and the following factors: amount of perspiration, fatigability, twitching, capillary resistance, mental alertness, and body build.

COMMENT

The reason for the low basal metabolic rates in rheumatic children and the even lower rates in the spring cannot be stated with certainty. There may be several factors. One seems especially important to us—that of continuous infection during the winter and spring months with subsidence in the summer and fall.

We believe the source of the infection to be a chronic suppurative sinusitis which was found to exist in all of our rheumatic children.[26] Almost all of the children under discussion in this paper were previously studied for signs of sinusitis. In this previous study we noted that 86 per cent had been tonsillectomized. Despite the removal of both tonsils and adenoids, 88 per cent exhibited cervical adenitis; 84 per cent, submaxillary adenitis; and 22 per cent, retropharyngeal adenitis.

It is significant that the highest incidence of adenitis was found in the spring of the year, at a time when sinus and rheumatic activity is at its height. The incidence and degree of involvement of these three groups of glands were lowest in the fall of the year, when sinusitis is least active clinically.

The drainage of infected sinuses to these three locations has been demonstrated both clinically and experimentally (Mullin and Ryder[28]). In nondraining sinuses the resultant tension is an important element in the production of symptoms (Sewall,[29] Greenfield,[30] and Crooks and Signy[31]): the toxins in the retained purulent secretion cause enlargement of the glands and then enter the blood stream. These toxins have been postulated as the cause of the low capillary resistance we noted

in our rheumatic children;[27] it is not unlikely that they also cause the muscle and joint pains.

The same toxins are probably responsible for damage to the thyroid gland, with consequent lowering of the basal metabolic rates. Chronic focal infections have been noted by Billings in 1914,[23] Beck,[15] and others as causes of thyroid intoxication and deficiency. From a study of 100 patients with thyroid deficiency, Beck (1918) concluded that chronic infections are almost invariably associated with insufficiency of thyroid; 36 per cent of his patients showed infection of teeth, tonsils, and sinuses. It is probable that, with lessening of sinus activity in the warm weather, bacterial intoxication diminishes, healing of thyroid tissue takes place, and the metabolism improves.

It is argued by some that hypothyroidism is a cause of arthritis rather than the result. We believe that a common factor, bacterial toxin, is responsible for both the joint and glandular damage. If the hypothyroidism were the cause of the joint damage, it would be difficult to explain both the onset and the seasonal variations of hypothyroidism. It seems more logical to agree with those who hold that toxins produce injury to both tissues. Thus Lee[10] states, "Hypothyroidism is a frequent symptom of the associated debility of chronic arthritis, but presumably it is an associated symptom of the debility and not a causative factor. . . . It is undoubtedly inept to consider the hypothyroidism as the direct causative agent." Similarly Rawls and co-workers,[9] discussing rheumatoid arthritis, state, ". . . infection probably plays a prominent role and lowered metabolism is only one of a long chain of effects." In focal arthritis Watson-Williams[8] agrees with Thomson and Gordon that the manifestations of hypothyroidism are "the result of toxic thyroiditis due to the same underlying agents as the other features of the disease."

CONCLUSIONS

1. The basal metabolic rate in many rheumatic children is below normal, averaging –7.6 per cent in a group of 97 patients; 43 showed at least one reading below –10 per cent; only 2 were increased (above +10 per cent).

2. Seasonal variations are noted; from values approaching normal in July to December, basal metabolic rates tend to drop in each trimonthly period from January to July.

3. A strong tendency is noted for the skin and hair of many rheumatic children to become dry in the winter and spring and to improve in the fall. These seasonal changes may be associated with corresponding changes in the activity of the thyroid gland.

4. The decreasing metabolism from January through June may be due to the toxic effect produced on the thyroid gland during and immediately following the season of greatest rheumatic activity.

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IMMUNIZATION AGAINST RHEUMATIC FEVER

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BETWEEN 1933 and 1941 we undertook to immunize several small groups of known rheumatic fever children (101 in all) with frequent subcutaneous injections of crude N. Y. 5 strain hemolytic streptococcus toxin. The results reported elsewhere[1, 2, 3] were encouraging. The number of diagnosed acute attacks of rheumatic fever was much reduced, and the patients were in better general health than their corresponding control groups. Patients treated between 1933 and 1937 were re-examined periodically until 1940, and we found that their good health was maintained.

However, the use of crude toxin involved some disadvantages, the chief one of which was the large number of visits to the clinic, each patient being expected to attend about thirty-eight times over a two-year period. Not all clinic patients and their families see such a long ordeal through to the end. Second, the physician had to limit his attention to a small and especially cooperative group of patients. Third, local reactions were frequent and severe, and general reactions occurred occasionally.

Naturally we began to cast about for a material analogous to a streptococcus toxoid or a modified toxin which would retain the active immunizing properties of crude toxin and yet could be given in fewer and larger doses without fear of a severe reaction. We turned at last to Dr. Milton V. Veldee, Surgeon, U. S. Public Health Service. For years he had used a tannic acid precipitated toxin of N. Y. 5 strain hemolytic streptococcus (the same strain that we had been using) for active immunization of several thousand school children against scarlet fever and had obtained excellent results.[4]

With Dr. Veldee we estimated that in our work we had been giving subcutaneously to each rheumatic fever patient 35,000 skin test doses over the two-year period. We decided to give the same number of skin test doses of attenuated toxin intradermally in four injections three weeks apart and to repeat the largest dose semiannually thereafter, beginning six months after the fourth inoculation. The four initial doses were graduated as follows: 5,000, 8,000, 10,000, and 12,000 skin test doses per 0.1 c.c. One-tenth of a cubic centimeter was injected intradermally with a short intradermal needle and a tuberculin syringe into the upper triceps area where the site of the injection is protected by a sleeve and attracts little or no attention. (We had previously found that an intradermal injection into the flexor surface of the forearm led to inspection, discussion, and scratching by the pa-

This work was carried out in the Cardiac Research Clinic, Department of Pediatrics, New York Post-Graduate Medical School and Hospital, Columbia University.

tient.) Not a single general reaction or abscess formation has been recorded following an injection. All patients have reported some itching at the site of the injection, and many have said that there was heat, tenderness, and redness where they were "stuck with the needle," but this never lasted for more than forty-eight hours.

All of our patients have been pleased by the shortness of the new course of treatment. In the past many had refused inoculations on the ground that they could not afford the time or the carfare to come to hospital eighteen or twenty times in the course of one winter. But the new treatment called for only five visits during the first winter and for two a year thereafter. All patients have been instructed to report at once in case of severe colds, nosebleeds, sudden joint pains, and violent abdominal symptoms.

In September, 1940, we began the use of Veldee's attenuated hemolytic streptococcus toxin, diluted to suit our purposes, on forty-two new rheumatic cardiac patients. The control group comprised thirty-three children. We have presented a preliminary report[3] on their condition and here we shall merely summarize it.

Of the forty-two patients, fifteen were girls and twenty-seven were boys. Their average age was 10.9 years. The number of reported colds per child was low; namely, 1.45. The mean gain in weight was 7.5 pounds in nine months. There were few subacute rheumatic symptoms. Two patients complained of frequent abdominal distress; three, rheumatic pains on more than two occasions; three, frequent headaches; and three, twitching. Not a single patient developed an attack of rheumatic fever, but one who has both congenital and rheumatic heart disease and is chronically decompensated, and another who, at the outset, had moderate chorea, showed no improvement. The blood picture of the children in the group was normal.

The control group for the winter of 1940-1941 consisted of seventeen boys and sixteen girls. Their mean age was 12.1 years. The number of reported colds per child was 2.9, and the mean gain in weight, 7.9 pounds. The subacute rheumatic symptoms were many and severe, except for the absence of nosebleeds. There were eleven attacks of acute rheumatic fever with three deaths.

The results appeared to us encouraging, especially because in September, 1940, we had selected for treatment the children who had been most ill during the preceding winter and especially during spring. The control group of thirty-three patients in September, 1940, included only five severe cardiac patients, whereas in the group of newly treated there were thirteen.

The forty-two treated children received their first semiannual inoculations during May or June of 1941, and in September and October thirty-one of them returned for further observation. All but two of the thirty-one received semiannual injections of the modified toxin in the course of 1941-1942. Two boys, when they were due for a semiannual

inoculation, developed an attack of acute rheumatic fever and had to be hospitalized. At the end of the attack they were sent to convalescent homes and thus received no inoculations. Of the eleven patients not seen again in 1941-1942, one was killed in a street accident, two refused to return because they felt well and could not be bothered, and eight were dispersed by war and could not be traced by the Social Service Department.

TABLE I

COMPARISON BETWEEN PATIENTS RECEIVING INOCULATIONS AND CONTROL PATIENTS DURING 1940-1941

	TREATED	CONTROL
Number of patients	42	33
Sex	27 males 15 females	17 males 16 females
Average age (yr.)	10.9	12.1
Number of reported colds per child	1.45	2.9
Mean gain in weight (lb.)	7.5	7.9
Abdominal symptoms		
+	8	4
++	5	4
+++	2	5
Pallor		
+	2	3
++	5	1
+++	4	12
Epistaxis		
+	3	3
++	1	4
+++	3	0
Rheumatic pains		
+	9	3
++	4	3
+++	3	14
Cardiac symptoms		
+	5	5
++	1	1
+++	3	10
Headaches		
+	11	1
++	4	1
+++	3	11
Twitching		
+	3	2
++	2	2
+++	3	4
Number of attacks of rheumatic fever, carditis, and chorea	0	11 (33%)
Deaths	0	3
Mean laboratory data:		
E. S. R. (mm. per hr.)	9	17
Hemoglobin (%)	76.1	73.2
Nonfilamented neutrophiles (%)	8.33	10.5

Symbols: +, occurred once; ++, occurred twice; +++, occurred more than twice.

Of the thirty-one children, seventeen were boys and fourteen were girls. Their average age was 11.8 years. The incidence of reported upper respiratory infections was the lowest yet for all groups treated between 1933 and 1942; namely, 1.3 per child. The mean gain in weight between September and June was 6.4 pounds.

Subacute rheumatic symptoms showed further abatement during the winter of 1941-1942. Abdominal symptoms were prominent in only one patient, chronic pallor in one, frequent joint pains in two, recurrent headaches in four, and mild though constant choreiform movements in one. The mean erythrocyte sedimentation rate (Landau's microsedimentation method was used exclusively) was 10.1 mm. per hour; average hemoglobin value, 79.5 per cent; and nonfilamented neutrophile count, 7 per cent.

TABLE II

COMPARISON BETWEEN PATIENTS RECEIVING SEMIANNUAL INOCULATIONS AND CONTROL PATIENTS DURING 1941-1942

	TREATED	CONTROL
Number of patients	31	29
Sex	17 males 14 females	14 males 15 females
Average age (yr.)	11.8	12
Number of reported colds per child	1.3	3 chronic 26 patients 2.3 mean for
Mean gain in weight (lb.)	6.4	3.8
Abdominal Symptoms		
+	7	6
++	1	4
+++	1	3
Pallor		
+	2	4
++	2	6
+++	1	4
Epistaxis		
+	5	5
++	0	0
+++	0	5
Rheumatic pains		
+	6	5
++	2	0
+++	2	5
Cardiac Symptoms		
+	5	4
++	0	9
+++	0	2
Headaches		
+	6	3
++	3	6
+++	4	11
Twitching		
+	0	4
++	0	3
+++	1	2
Number of attacks of rheumatic fever, carditis, and chorea	2 (6.4%)	6 (20.7%)
Mean laboratory data:		
E. S. R. (mm. per hr.)	10.1	12.5
Hemoglobin (%)	79.5	75
Nonfilamented neutrophiles (%)	7	9

Symbols: +, occurred once; ++, occurred twice; +++, occurred more than twice.

The control group for the same winter consisted of twenty-nine children, fourteen of whom were boys and fifteen, girls. Their mean age was 12 years. In three children the number of upper respiratory infections could not be estimated, as their colds accompanied by chronic

sinusitis were continuous. The rest reported on an average 2.3 colds between September and June. The mean gain in weight was 3.8 pounds. Three children had frequent abdominal symptoms, four chronic pallor, and five almost chronic joint and muscle pains. Headaches were a constant complaint in eleven patients. Six children (20.7 per cent) suffered attacks of acute rheumatic fever. The hematologic study showed an average of 12.5 mm. per hour for the erythrocyte sedimentation rate, 75 per cent for hemoglobin, and 9 per cent for the nonfilamented neutrophile count.

In Fig. 1 we have taken the erythrocyte sedimentation rate curve as the most constant single index of infection[5] and have plotted it in terms of monthly averages for two consecutive winters for the same groups of treated and control patients.

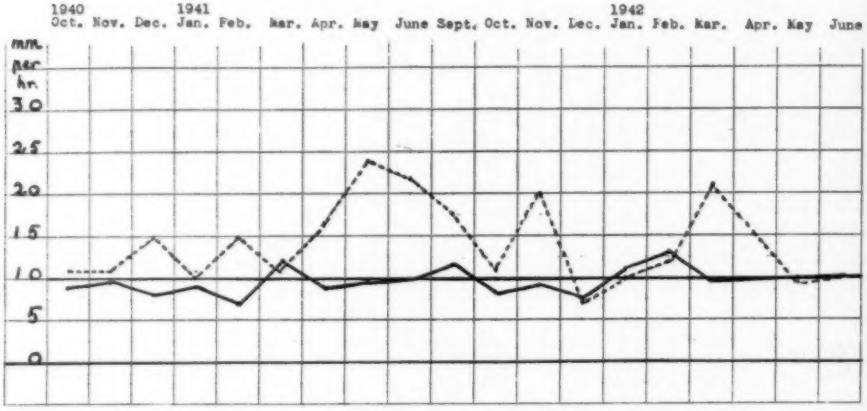

Fig. 1.—Comparison of the mean monthly sedimentation rate values between treated and control patients from October, 1940, to June, 1942. ———, Treated group; - - - - - -, control group.

In the patients in the treated group the curve shows a close adherence to normal values with only slight seasonal fluctuations for two consecutive winters, while that of the patients in the untreated group exhibits wide variations above the normal level.

In September, 1941, encouraged by the experience of the preceding winter with what we termed the "short treatment," we began the immunization of another group of thirty-eight known rheumatic fever patients made up of seventeen boys and twenty-one girls. Their mean age was 9.9 years and the mean gain in weight was 4 pounds.

In comparison with the control group of twenty-nine children for 1941-1942 already discussed, these new patients showed a good rheumatic and general health record. Frequent abdominal symptoms occurred in one patient, chronic pallor in four, and frequent joint pains also in four. Choreiform twitchings and precordial pain were more frequent than in the control group, however. Whereas six of the twenty-

TABLE III

COMPARISON BETWEEN PATIENTS RECEIVING INOCULATIONS AND CONTROL PATIENTS DURING 1941-1942

	TREATED	CONTROL
Number of patients	38	29
Sex	17 males 21 females	14 males 15 females
Average age (yr.)	9.9	12
Number of reported colds	1.4	3 chronic 2.3 mean for 26 patients
Mean gain in weight (lb.)	4.0	3.8
Abdominal symptoms		
+	8	6
++	1	4
+++	1	3
Pallor		
+	6	4
++	4	6
+++	6	4
Epistaxis		
+	2	5
++	0	0
+++	1	5
Rheumatic pains		
+	4	5
++	5	0
+++	4	5
Cardiac symptoms		
+	2	4
++	1	9
+++	4	2
Headaches		
+	3	3
++	5	6
+++	4	11
Twitching		
+	2	4
++	0	3
+++	4	2
Number of attacks of rheumatic fever, carditis, and chorea	1 probably (2.6%)	6 (20.7%)
Mean laboratory data:		
E. S. R. (mm. per hr.)	11	12.5
Hemoglobin (%)	80	75
Nonfilamented neutrophiles (%)	8.5	9

Symbols: +, occurred once; ++, occurred twice; +++, occurred more than twice.

nine patients in the control group suffered attacks of acute rheumatic fever, thirty-seven of the thirty-eight treated patients suffered none. The thirty-eighth patient was sick in bed for a week with what the local doctor diagnosed as "grippe," but we who did not see the patient during the time assume that it was an acute rheumatic attack.

SUMMARY AND COMMENT

Between September, 1940, and June, 1942, eighty ambulatory rheumatic cardiac children received an average of six inoculations of tannic acid precipitated toxin of N. Y. 5 strain hemolytic streptococcus intradermally in an effort to forestall recurrences of rheumatic fever attacks. Our records show that not one of them, following an inocula-

tion, suffered a general reaction of abscess formation, but local reactions were almost universal. There was tenderness, swelling, and redness at the site of the injection. All of the children complained of local itching for about forty-eight hours. Those local reactions were so slight that no parent or child reported them, except in reply to our inquiry.

This "short method" of immunization that we have used since the fall of 1940 seems to compare favorably with the method used between 1933 and 1941. The end results appear equally good in conferring what may prove a lasting immunity against acute rheumatic re-infections. The following differences in the two methods of immunization should be noted. The "long method" consisted of at least thirty-eight inoculations of crude toxin given subcutaneously over a period of two years. This method not only produced occasionally unpleasant reactions, but also put a severe strain on the endurance of the patient and on that of the physician who, for two years, had to devote his attention to a small and especially cooperative group of treated patients and to an equally small and less cooperative group of control patients. This introduced the factor of unusual care in the treatment of children who were willing to be seen twenty times a year.

In all, we have treated eighty ambulatory rheumatic fever patients against recurrences of rheumatic fever attacks since the fall of 1940. In 1940-1941 forty-two treated patients suffered no relapses, whereas in the control group of thirty-three there were eleven patients who suffered attacks with three deaths. Of those forty-two children, thirty-one reported for treatment during the winter of 1941-1942, but of the thirty-one, two suffered acute rheumatic fever attacks and received no prophylactic inoculation. The twenty-nine control patients for the same winter showed six children laid up with rheumatic fever. A new group of thirty-eight patients began a course of treatment in September, 1941, and among them there was only one possible attack of acute rheumatic fever during the ensuing winter, as compared with six attacks in the control group of twenty-nine.

CONCLUSION

After nine years of experience with immunization, first with crude and later with attenuated hemolytic streptococcus toxin, against recurrences of rheumatic fever attacks, we feel in a position to say, first, that the children suffer no harm, and, second, that in most cases they are much benefited by the prophylactic treatment.

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HEMATOLOGIC AND RADIOLOGIC STUDY OF INFANTS RECEIVING MASSIVE DOSES OF VITAMIN D* IN RICKETS PROPHYLAXIS

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CHEMICAL AND RADIOLOGIC STUDIES

RECENT publications have called attention to the use of single massive or shock doses of vitamin D given either by enteral or parenteral means in the cure or prevention of rickets.

In 1928 Vollmer[1] first demonstrated that rats could be protected against rickets by a single massive dose of vitamin D, and in recent years considerable data have been published which establish the efficacy of this method. It appears that until recently its actual use was confined mainly to Germany, probably because of wartime necessity. It is apparent from a review of the literature that the degree of safety or toxicity of this form of rickets prophylaxis varies with the type of vitamin D used.

Bills[2] has shown that ultraviolet irradiation of ergosterol produces the following successive reactions: ergosterol, lumisterol, tachysterol, calciferol (vitamin D_2). When irradiation is carried further, toxisterol is formed. Calciferol, or vitamin D_2, is the only potent antirachitic agent produced in this chain of reactions. Tachysterol and toxisterol, on the other hand, when administered in sufficient dosage may produce very deleterious effects.

McLean[3] has effectively reviewed the literature on large dose vitamin D usage and states that, while these amounts of vitamin D used appear to be enormous, there is little evidence of harmful effects from such doses when administered over relatively short periods of time.

Vollmer[4] has shown that a single dose of 600,000 units of vitamin D_2 is only one-fifth of the toxic dose to infants, and since it is given only once over a period of months in the prevention of rickets, it is far below the limits of risk. Vollmer[1, 4, 5] has given a large number of infants and older children this dose of vitamin D both orally and parenterally and did not encounter any clinical signs of toxicity.

CLINICAL STUDY

The purpose of our study was to investigate the antirachitic value and safety of a single massive oral dose of an electrically activated ergosterol† in normal infants. The use of smaller doses given once a

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*The preparation used was Ertron, an electrically activated vaporized ergosterol (Whittier Process), which was furnished by the Nutrition Research Laboratories, Chicago, Ill.

†Whittier process.

TABLE

BLOOD

CASE	PATIENT	ANTIRACHITIC AGENT	FIRST MONTH					SECOND MONTH					THIRD MONTH				
			R. B. C.	HEMOGLOBIN	W. B. C.	CALCIUM	PHOSPHORUS	R. B. C.	HEMOGLOBIN	W. B. C.	CALCIUM	PHOSPHORUS	R. B. C.	HEMOGLOBIN	W. B. C.	CALCIUM	PHOSPHORUS
I	P. A.	Cod-liver oil (Daily)	3.78	12.7	.....	10.2	6.81	3.66	10.3	5,300	9.5	6.42	3.74	11.1	8,000	10.3	6.81
II	C. J. M.	Cod-liver oil (Daily)	4.11	11.9	9,850	11.4	7.46	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
III	F. S.	Cod-liver oil (Daily)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.31	10.1	7,700	10.5	6.42
IV	M. L.	Cod-liver oil (Daily)	3.47	10.4	7,650	9.8	8.13	3.75	11.0	5,950	9.8	6.95	4.29	11.4	8,600	8.6	7.46
V	R. McM.	Cod-liver oil (Daily)	.....	.....	.....	.....	.....	4.04	11.6	8,850	9.97	5.56	3.40	9.0	8,600	9.9	6.8
VI	B. G.	Viosterol (Daily)	2.72	9.4	12,150	9.5	8.27	2.80	10.0	10,550	9.9	7.38	3.91	10.3	12,550	10.1	6.42
VII	R. G.	Viosterol (Daily)	3.84	12.0	8,400	10.2	6.42	3.19	10.2	8,150	9.6	6.74	3.78	10.5	9,850	11.2	6.24
VIII	A. C.	Ertron, 100,000 units (Monthly)	.....	.....	.....	.....	.....	3.48	10.2	12,100	9.87	6.74	3.15	9.4	8,700	10.2	6.54
IX	P. B.	Ertron, 100,000 units (Monthly)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
X	G. C.	Ertron, 100,000 units (Monthly)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.42	9.7	8,850	9.7	5.43
XI	J. B.	Ertron, 100,000 units (Monthly)	.....	.....	.....	.....	.....	4.59	14.3	.....	9.50	5.86	3.57	10.0	6,950	10.3	6.39
XII	G. J. K.	Ertron, 600,000 units (Single dose)	4.37	12.8	6,600	10.6	7.54	.....	.....	.....	.....	.....	4.20	12.4	9,500	10.7	6.95
XIII	C. P.	Ertron, 600,000 units (Single dose)	.....	.....	.....	.....	.....	3.55	10.5	12,050	10.13	7.23	3.29	9.5	8,200	11.2	6.54
XIV	B. J. K.	Ertron, 300,000 units (Single dose)	3.28	9.0	6,650	10.4	8.22	3.47	10.0	5,250	9.6	7.16	4.14	10.6	3,850	9.8	5.86
XV	P. M.	Ertron, 600,000 units (Single dose)	4.12	12.6	7,750	10.9	7.02	3.65	11.9	9,450	10.8	6.67	4.29	12.0	11,400	10.3	6.18
XVI	K. W.	Ertron, 600,000 units (Single dose)	3.34	10.0	6,050	9.9	6.74	.....	.....	.....	10.44	6.67	3.93	10.9	7,900	10.6	5.96
XVII	B. L.	Ertron, 300,000 units (Single dose)	.....	.....	.....	.....	.....	3.49	10.3	6,850	9.00	7.16	3.92	10.5	11,300	10.5	6.54
XVIII	P. B.	Ertron, 600,000 units (Single dose)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.71	10.2	6,850	10.3	5.13
XIX	P. M.	Ertron, 600,000 units (Single dose)	5.00	16.3	6,500	9.82	6.54	3.84	11.2	6,200	10.00	5.66	3.82	9.8	7,150	9.34	9.24

month was also investigated. This study was carried out from October, 1941, to April, 1942. Data collected during the remainder of the year, when sunshine is rich in ultraviolet rays, may be very misleading. Forty infants were divided into four groups of ten each. The infants in Group I each received 600,000 U. S. P. units of vitamin D in one day, orally. Those in Group II received 100,000 U. S. P. units of vitamin D in a single dose each month for six months. Those in Group III received three teaspoonfuls of cod-liver oil a day; and the infants in Group IV, fifteen drops of viosterol once per day.

Due to a variety of circumstances well known in clinical practice, it was possible to follow closely only nineteen of these infants. These nineteen included eight infants of Group I, who received 600,000 U. S. P. units in a single day, four of Group II, who received 100,000 U. S. P. units once a month for six months, five of Group III, who received cod-liver oil, and two infants, twins, of Group IV, who were given viosterol. All of these infants were white except two in Group I and one in Group III.

I

CONSTITUENTS

FOURTH MONTH					FIFTH MONTH					SIXTH MONTH					SEVENTH MONTH				
R. B. C.	HEMOGLOBIN	W. B. C.	CALCIUM	PHOSPHORUS	R. B. C.	HEMOGLOBIN	W. B. C.	CALCIUM	PHOSPHORUS	R. B. C.	HEMOGLOBIN	W. B. C.	CALCIUM	PHOSPHORUS	R. B. C.	HEMOGLOBIN	W. B. C.	CALCIUM	PHOSPHORUS
3.70	11.8	7,400	11.2	6.81	.....	.....	.....	10.4	6.95	3.92	11.8	8,500	9.6	7.78	4.40	13.0	6,900	9.90	7.02
.....	.....	.....	.....	.....	4.20	10.8	8,900	10.7	6.95	.....	.....	.....	.....	.....	4.54	12.4	6,100	10.0	7.54
4.0	11.6	6,800	11.0	6.42	4.33	11.4	9,800	10.2	6.81	4.09	11.1	.....	10.0	7.09	4.70	12.2	9,000	9.28	7.54
4.35	11.1	9,600	10.9	7.38	3.95	11.6	8,500	9.3	7.46	4.22	12.8	7,400	9.4	6.54	4.36	13.4	8,200	8.96	7.23
3.73	9.3	10,050	10.3	7.02	4.10	11.5	8,750	10.3	6.74	4.10	11.3	7,500	9.8	6.54	4.39	11.5	7,301	9.15	7.16
4.03	12.9	12,500	.....	.....	4.25	11.6	13,600	11.1	7.16	4.33	12.4	13,150	.....	.....	3.92	11.5	9,250	9.15	7.45
3.53	9.9	8,850	11.5	7.16	4.22	10.5	12,200	8.8	7.62	4.54	9.9	12,950	.....	.....	4.69	10.7	9,150	8.96	6.38
3.65	11.0	8,350	10.8	7.3	4.00	12.3	6,550	10.0	7.30	4.51	12.6	8,800	.....	.....	4.18	11.4	9,800	9.49	7.38
3.77	11.9	11,900	11.9	6.95	3.81	11.7	9,150	9.7	7.46	3.56	.....	12,850	9.5	7.02	.....	11.0	12,950	9.8	6.88
4.06	11.1	8,200	10.7	7.23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3.49	9.9	5,500	11.2	6.54	4.14	12.7	9,900	10.7	7.54	4.47	11.8	8,850	10.2	6.67	4.75	.....	.....	.....	.....
4.97	11.5	10,200	10.2	5.76	.....	.....	.....	.....	.....	4.26	9.5	5,700	9.5	6.76	.....	.....	.....	.....	.....
4.08	11.4	5,900	12.21	7.38	4.56	11.5	10,900	9.8	7.09	4.78	12.4	8,750	10.4	7.23	4.56	12.3	6,700	9.9	7.23
4.61	11.0	6,850	10.0	6.12	4.27	9.6	5,850	10.5	6.95	4.64	10.6	7,100	9.0	6.67	4.54	11.7	4,800	9.9	6.88
4.36	12.3	10,700	11.5	7.02	4.39	12.2	10,150	9.8	6.36	5.13	13.1	11,150	9.49	9.06	4.44	11.2	13,350	9.68	9.70
.....	.....	.....	.....	.....	4.12	11.2	6,100	9.7	8.32	4.12	10.9	6,700	8.4	7.87	4.12	10.6	8,250	9.07	7.23
4.46	11.5	11,500	11.0	8.04	4.53	11.6	11,000	9.4	7.38	4.0	.....	.....	.....	.....	3.90	12.0	12,250	9.15	7.45
4.53	11.4	7,150	10.8	7.09	4.27	12.7	7,450	9.4	6.81	4.49	12.2	6,100	10.2	6.18	4.34	13.0	6,500	10.0	6.42
4.02	11.6	7,750	11.5	6.60	4.36	11.1	5,700	9.9	8.12	4.30	10.5	9,450	9.56	6.88	3.92	11.0	8,150	9.22	7.23

Since most infants are given some form of vitamin D before they are a month old, six infants in this series had already received some vitamin D prior to this study. All of the infants, at the beginning of the study, were all placed on nonirradiated milk, which was furnished free to them. At three to four months they were given nonirradiated cereal, and at four to five months, strained vegetables were added. Strained fruits were given at six months. Vitamin C was given in the usual manner. The vitamin D used in this study was an electrically activated vaporized ergosterol, which was supplied in capsules, each of which contained 50,000 U. S. P. units of vitamin D. This substance is completely miscible in milk, and an equal part of the day's dosage was given in a small portion of each bottle just before the regular feeding. This was done so that none would remain if a portion of the feeding was refused. A nurse visited the home of each infant the day after the administration of vitamin D to make certain that no vomiting, regurgitation, or refusal had occurred. In the period during which the infant was

being studied in the clinic, frequent home visits were also made to ascertain that no substitution of milk or other feedings were taking place.

LABORATORY AND CLINICAL DATA

At each monthly visit of the infant to the clinic, blood calcium and phosphorus levels were determined, and roentgenograms of the long bones were made. Complete blood counts were done monthly to make certain that no harm occurred from the repeated withdrawal of blood necessary for the chemical determinations. The cellular and chemical constituents of the blood of each infant were determined at each visit to the clinic and are tabulated in Table I. It was not practical to examine the urine of these infants in an outpatient clinic.

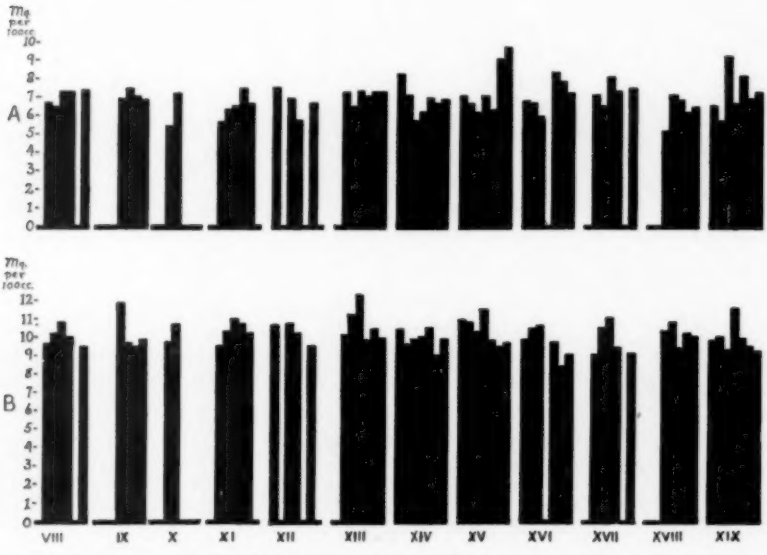

Fig. 1.—*A*, Serum phosphorus expressed as milligrams per 100 c.c. *B*, Serum calcium expressed as milligrams per 100 c.c.

The heavy line at the base indicates the seven-month period of observation. Each vertical column represents one monthly determination. Patients are designated by the Roman numerals.

None of the infants receiving the massive dose of vitamin D showed any sign of toxicity from the substance, and no instance of vomiting was recorded. None of these patients showed any clinical or laboratory signs of rickets. In no instance did the calcium level go beyond normal limits, although no determinations were made immediately after the administration of the antirachitic agent. In Fig. 1 the calcium and phosphorus levels for each patient are shown graphically.

The two infants who received fifteen drops of viosterol each showed craniotabes at 4 months of age and flaring and cupping at the distal end of the radius and ulna and the upper end of the fibula. Calcium

and phosphorus levels of the blood serum were normal. At 5 months these infants were given 600,000 U. S. P. units of vitamin D. At 6 months the craniotabes were absent, and at 8 months the roentgenograms were normal. There was no deviation from the normal calcium and phosphorus levels during this period of healing.

The growth curve was normal in all, except one Negro infant (Case XIV). In Table II the weights of each infant are tabulated.

COMMENT

As other investigators have suggested, a certain portion of the vitamin D ingested must be stored in the body and be available at all times. Heymann[6] found small quantities of vitamin D in the blood stream of rabbits three months after a single large oral dose. He later showed that, in rabbits given 200,000 units of vitamin D in oil by mouth and killed from one to twelve weeks later, vitamin D could be demonstrated in the brain, lungs, kidney, skin, liver, red cells, and plasma during this time.

Vollmer[7, 8] found that when massive doses of vitamin D were administered to infants, most of it was stored in the skin, the liver, and the brain. Less was found in the kidney. No appreciable amounts were found in the lung, the spleen, or the bones.

The results obtained from our series of infants and those of other investigators give promise that the single dose method of vitamin D administration may well become the method of choice in the future. Vollmer[4, 5] has used this method in one hundred and fifty-eight children for various clinical purposes, in doses ranging from 250,000 to 600,000 units. In no instance did any clinical signs of toxicity occur, and no calcium-containing casts were found in the urine.

Zelson[9] used massive doses of vitamin D orally and parenterally in forty-six premature infants and was able to follow seventeen of them for a reasonable length of time. None of the forty-six premature infants showed any signs of toxicity. Rickets appeared in only one premature infant, a female colored child who weighed 3 pounds, 8 ounces at birth. This Negro infant, who received 500,000 units at 3 weeks of age, developed rickets at the fourth month of age and was given a second oral administration of 600,000 units which produced rapid healing. Zelson suggested that premature infants should be given their first massive dose very early, approximately in the third week of life, and that it should be repeated three months later. Subsequently, premature infants resemble infants born at term in their vitamin D requirement. Zelson concluded that rickets can be prevented for at least three months by the parenteral administration of 600,000 units of vitamin D.

Wolf[10] administered orally 600,000 U. S. P. units of vitamin D to each of seventy-five infants. He studied sixty-two of these during the

TABLE

WEIGHT OF INFANTS

CASE	PATIENT	BORN	OCT.	NOV.			DEC.			JAN.	
			23	6	13	27	4	11	18	15	29
I	P. A.	9/25		161			194				236
II	C. M.	9/ 6		171		187					
III	F. S.	11/ 1							168	206	
IV	M. L.	9/ 6		144			169			225	
V	R. M.	10/24							147	178	
VI	B. G.	10/12	107		125			166		213	
VII	R. G.	10/12	94	103	114			151		202	
VIII	A. C.	10/20							160	193	
IX	P. B.	1/12									
X	G. C.	10/23							153	192	
IX	J. B.	11/17							120	120	
XII	G. K.	9/29		133		164					
XIII	C. P.	10/15							159	191	
XIV	B. K.	11/14		110		116				166	
XV	P. M.	10/13				157				216	
XVI	K. W.	10/ 4				166					
XVII	B. L.	9/26				180	194			239	
XVIII	P. B.	10/16				128	137			158	
XIX	P. M.	10/13				131				190	

entire experimental period. Serial roentgenograms were taken of forty-three of the infants. At the onset of this study, eighteen showed mild rickets, all of which healed after the administration of a single massive dose of vitamin D. Wolf concluded from this and from his previous study[11] that the administration of a single massive dose of a form of vitamin D (ertron) for the prophylaxis of rickets is effective and safe.

Brockman[12] reported that in sixty infants the single oral dose of 600,000 units of vitamin D_2 or D_3 to infants is sufficient to prevent rickets for three to four months during the winter season and advocates a repeat dose at that time to carry them through the rest of the winter. However, thirteen of this group did develop craniotabes and lowered serum phosphorus levels.

Harnapp[13, 14] has reported on the findings in a group of seventy-one infants who were given from 200,000 to 400,000 units of vitamin D in a single oral dose. They were followed clinically and roentgenographically from December to mid-February. One infant, who received 200,000 units, developed rickets. The period of time in his study is too short to be conclusive. In a further study the next year, Harnapp[15] described

II

IN OUNCES

FEB.				MARCH				APRIL					MAY			JUNE
5	12	19	26	5	12	19	26	2	9	16	23	30	7	21	28	4
		263					279				297					
														294		
227				241				264				278			300	
		249					278				295			306		
	204				234					270				284		
		244				282			290		301			320		
		232				265					290			290		
							250				262			280		
			202				240							307		
			242						275							
	145				169				185		192		203			
	236										275		273			
		224				244							295			
						208										231
		271						307							343	
			234				244				259			280		
		284				307					334			336		
	171				178	183				197			208			
		237						278				292			316	

a group of one hundred infants who were given from 200,000 to 400,000 units orally and were followed from four to six months. He found that no rickets developed if at least 300,000 to 600,000 units were given.

Schwartzer,[16] Heisler,[17] and Hofmeier[18] have also found that if adequate doses of from 400,000 to 600,000 units are given, no rickets result.

SUMMARY

1. The use of a single massive oral dose of an electrically activated vaporized ergosterol, containing 600,000 U. S. P. units of vitamin D, was effective in preventing rickets in a group of infants studied during the fall and winter months.

2. The use of repeated smaller doses of 100,000 U. S. P. units of the same antirachitic agent given monthly during this period of time (October to April) was also effective in preventing rickets in each of the infants studied.

3. No toxic clinical or laboratory findings occurred in any of the infants receiving this type of prophylaxis.

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SIGNIFICANCE OF PLASMA ASCORBIC ACID LEVELS IN NEBRASKA CHILDREN

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ATTEMPTS to evaluate levels of ascorbic acid in the plasma in children and attach a significance to them have led to a variance of opinions. The ease of plasma ascorbic acid determination in contrast to the more cumbersome "saturation" tests spurs us on to delve further. For the recent voluminous bibliography, one may refer to Gyorgy's recent review[1] where it is stated "the normal level of ascorbic acid in human blood plasma is 0.7 mg. per cent." Levels below this have been interpreted as due to an insufficient intake, an increased demand as in infection, or an actual deficiency or tissue unsaturation.

Doubt as to whether or not a level of 0.7 mg. per cent or more is actually the standard toward which to strive has been expressed by Holmes, Cullen, and Nelson.[2] They hold that repeated determinations over a period of time may represent a measure of vitamin C storage, and in some of their cases observed over a period of ten months a low level persisted in apparently healthy children. In three groups of children, one from an orphanage, one from the Children's Hospital, and one from a convalescent group, they found the incidence of low levels (below 0.5 mg. per cent) to be about the same, even though the children in the first group were apparently quite healthy and those in the other two groups had infections.

Their findings are supported somewhat by Bessey and White,[3] who felt that three ounces of orange juice added to the diet appeared adequate for children between 5 and 13 years of age. A few individuals were low on the three-ounce intake, also low on four- and five-ounce intakes, and remained below 0.7 mg. per cent.

Our present investigation seeks to throw further light on these problems, utilizing children admitted to the University Hospital in Omaha, from every part of the state of Nebraska and representing the lowest income group.

METHODS

A vitamin C determination was done on each patient the morning following admittance whenever possible. With the exception of patients showing clinical

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signs of scurvy, the vitamin C content was checked every four or five days as long as the patient remained in the hospital. Those with scurvy had determinations daily.

Fasting blood was allowed to drop from a prick in the finger into the depression of a spot plate containing the double oxalate mixture described by Kato.[4] Sufficient blood was taken to allow for 0.2 c.c. plasma. Immediately after drawing the blood it was centrifuged to separate the plasma from the cells. The vitamin C content of the plasma was then determined without delay, using the micromethod of Mindlin and Butler[5] for the photoelectric colorimeter. The determinations were completed within an hour after the bloods were obtained. The vitamin C content of the orange juice was found by diluting the juice, adding metaphosphoric acid to 2.5 per cent concentration, filtering, and then applying the micromethod of Mindlin and Butler as for blood.

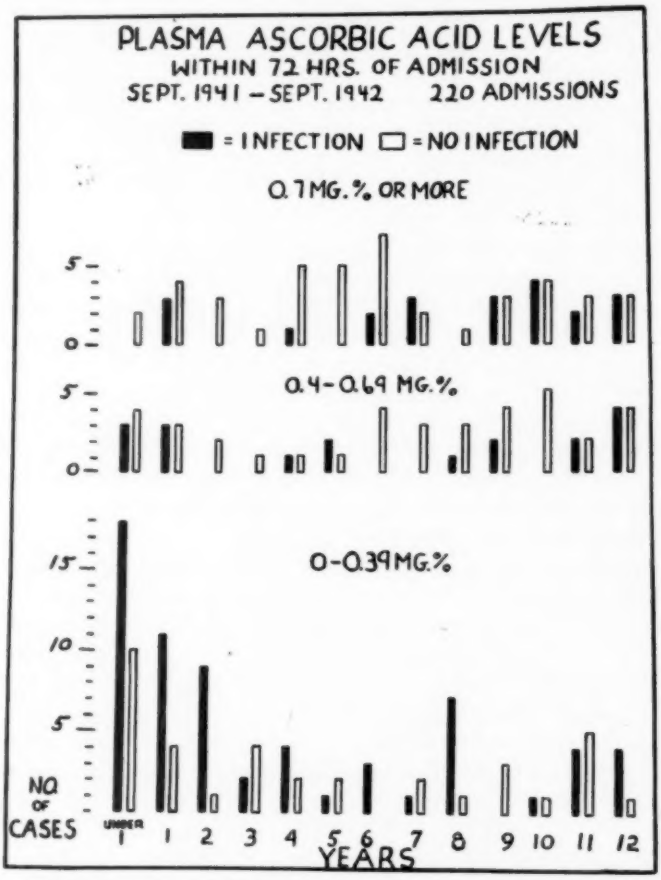
PLASMA ASCORBIC ACID LEVELS
WITHIN 72 HRS. OF ADMISSION
SEPT. 1941 – SEPT. 1942 220 ADMISSIONS
= INFECTION = NO INFECTION
0.7 MG.% OR MORE
0.4-0.69 MG.%
0-0.39 MG.%
NO OF CASES
UNDER 1
1 2 3 4 5 6 7 8 9 10 11 12
YEARS

Fig. 1.—Distribution of children according to age, with or without infection, in the normal (0.7 mg. per cent or more), borderline (0.4 to 0.69 mg. per cent), and low (0 to 0.39 mg. per cent) groups of plasma ascorbic acid levels on admission.

RESULTS

In Fig. 1 is summarized the age and frequency distribution of our series. The three groups of admission ascorbic acid values were selected to conform to the prevalent opinion of low (0-0.39 mg. per cent), borderline (0.4-0.69 mg. per cent), and normal (0.7 mg. per cent or above). The incidence of infections is almost exactly the same in the intermediate and normal groups, 33.9 per cent and 32.8 per cent, respectively, but in the lowest group that incidence rises to 64.3 per cent (Fig. 2). This figure also apparently differentiates the effect of infection on the vitamin C concentration at the 0.4 mg. level.

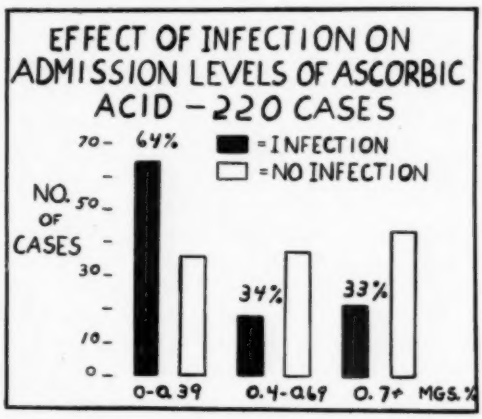

Fig. 2.—Incidence of children with infection in the normal (0.7 mg. per cent or more), borderline (0.4 to 0.69 mg. per cent), and low (0 to 0.39 mg. per cent) groups; all ages. Percentage figures represented are those considering the part of each group affected.

Age distribution in the three groups is fairly evenly divided with the exception of the first year of life in the lowest group. Of thirty-six noninfected children of all ages entering with plasma levels in the lowest group, there were ten infants under 1 year of age. Of sixty-five children of all ages with infection, also entering with the lowest level, there were eighteen under 1 year of age, eleven from 1 to 2 years of age, and nine from 2 to 3 years of age in the lowest group (0-0.4 mg. per cent). These figures probably indicate the increased number of infections to be found in these age groups. It is also true, of course, that a low dietary level may be an important factor in the low levels found in these age groups. No attempt was made to correlate the admission plasma level with the type and duration of the infection or the dietary history, because it was found early in our study how unreliable and indefinite statements of parents were.

One hundred eighty-one of 220 subjects had repeated plasma determinations to ascertain whether a given patient (1) would maintain a normal level on ward diet; (2) would increase his plasma level on such

a diet; (3) would respond to ascorbic acid additions. For purposes of study, the patients were divided into children with infection and children without infection.

WARD DIET

The diet as served to children on the pediatric ward at the University Hospital, exclusive of orange juice, was estimated to contain approximately 10 to 20 mg. of ascorbic acid. Four ounces of orange were added and included in our term "ward diet." These oranges were assayed and found to vary from 12 to 15 mg. per ounce. The daily intake may then be assumed to have varied between 60 and 80 mg. of ascorbic acid. Infants under 1 year of age were given from two to four ounces of orange juice daily, and the ascorbic acid furnished by added supplementary foods was considered too small to be of significance.

Of forty-three subjects who entered the hospital without infection in the normal group (0.7 mg. per cent or more), only three did not maintain that level. One was a 5-month-old infant with a meningocele whose level dropped from 0.71 mg. per cent on admission to 0.5 mg. per cent over a period of seventeen days on a daily intake of four ounces of orange juice. The second was an 11-year-old boy with a fractured arm whose plasma level dropped from 0.94 to 0.63 mg. per cent in five days. The third was a 12-year-old boy with a traumatic cataract whose level dropped from 0.81 to 0.55 mg. per cent in three days. Longer observation on the last two of these patients was not feasible, and it is possible that a return to above 0.7 mg. per cent might have shown up later.

Of twenty-nine patients who entered without infection in the borderline group (0.4 to 0.69 mg. per cent), twenty-four raised their levels to 0.7 mg. per cent or above during periods varying from two to thirteen days. One case in the borderline group was an 8-year-old boy with an anemia due to loss of blood, who was admitted with a value of 0.6 mg. per cent that rose to 0.96 mg. per cent twenty-four hours after 100 mg. of vitamin C were added to the ward diet. His level may have come up on the diet alone. Of the remaining four cases, two were infants, 18 and 22 months of age, with diagnoses of leukoma of the cornea and epilepsy, respectively. The level of the first remained between 0.55 and 0.6 mg. per cent over a period of eighteen days, and the second, 0.56 to 0.64 mg. per cent over a period of nineteen days. They ate well and appeared quite normal. The levels of two more infants dropped to below 0.4 mg. per cent, a spastic 3-month-old infant who did not take orange juice well, whose value dropped from 0.4 to 0.17 mg. per cent over fourteen days, and a 6-week-old infant with congenital heart disease whose values dropped from 0.41 to 0.1 mg. per cent on two ounces of orange juice over a thirteen-day period.

Twenty-four children without infection, from the lowest group (0 to 0.39 mg. per cent on admission) were followed, and of these, the levels of

eleven rose to 0.7 mg. per cent or more on the ward diet in from four to seventeen days. The levels of four patients went above 0.4 mg. per cent but remained below 0.69 mg. per cent. The periods of observation were eleven, eleven, six, and fourteen days, respectively. Whether these children would have remained at that level over a longer period is, of course, problematic. The levels of two patients of this group did not rise above 0.4 mg. per cent, a microcephalic 3-month-old infant who was difficult to feed, observed over nine days, and a 4-year-old patient with neurofibromatosis observed over ten days. The remainder of the children in this group was placed on added vitamin C and will be discussed in another section.

In summarizing all of the cases without infection, it is apparent that the ward diet is able to maintain or raise the plasma level to 0.7 mg. per cent in eighty of ninety-six children. Four more may have attained this, if observed longer.

In following the patients entering with infection, there were twenty-one who entered in the normal level group (0.7 mg. per cent or more), and, of these, only one fell from 0.7 to 0.5 mg. per cent in five days. This patient, 4 years of age, was suffering from an acute gingivostomatitis and took only two to three ounces of orange juice daily.

The group with infections who entered in the borderline group (0.4 and 0.69 mg. per cent) numbered thirteen. During periods of from four to twenty days, seven rose above 0.7 mg. per cent on the ward diet. One child, 1 year of age, with an abscess of the hip present for two weeks, had levels of 0.64 and 0.65 mg. per cent five days apart. Three of the thirteen fell below the 0.4 mg. per cent level, a 9-year-old girl with a draining osteomyelitis, a 12-year-old boy with an acute osteomyelitis, and a 4-month-old premature infant with oral thrush. The observation periods in these cases were eight days, fifteen days, and seven days, respectively. The infant took only 1 ounce of orange juice daily.

Fifty-one patients with infection entered with levels below 0.4 mg. per cent. Twenty-four were able to go above 0.7 mg. per cent on a ward diet in from two to twenty-five days. Five raised their levels from 0.4 mg. per cent to 0.69 mg. per cent in from three to ten days in spite of persistent infection. Six patients did not respond to the ward diet, five of whom had upper respiratory infection and one a severe diaper rash. The latter was an 8-month-old infant who did not respond in five days to two ounces of orange juice daily. The longest period of observation in these 6 cases, however, was only 7 days.

Thus, considering the eighty-five patients with infections who were followed, we found that fifty-one attained a level of 0.7 mg. per cent or more and six attained levels of from 0.4 to 0.69 mg. per cent, utilizing the ward diet.

TABLE I

ADDED ASCORBIC ACID

ADMISSION LEVEL = 0 TO 0.39 MG. PER CENT; LEVELS RAISED TO 0.7 MG. PER CENT OR MORE

NAME	AGE	DIAGNOSIS	DOSAGE	DAYS OF VITAMIN THERAPY OBSERVED TO PRODUCE LEVEL	
		No Infections			
S. W.	9 mo.	Scurvy	8 oz. orange juice	9	
M. E.	12 yr.	Meckel's diverticulum with perforation	100 mg. ascorbic acid	4	
D. M.	9 mo.	Subclinical scurvy; malnutrition	100 mg. ascorbic acid + 4 oz. orange juice	6	
N. B.	9 mo.	Scurvy	3 to 8 oz. orange juice 50 to 100 mg. ascorbic acid + 1 to 4 oz. orange juice	15 6	(See Fig. 3)
		Infections			
J. H.	6 mo.	Seborrhea; abscess scalp	4 oz. orange juice	10	
J. S.	9 mo.	Pneumonia; peritonitis	8 oz. orange juice	21	
L. A.	8 mo.	Repeated colds	100 mg. ascorbic acid + 1 to 3 oz. orange juice	3	
R. R.	9 mo.	Scurvy; cold	100 mg. ascorbic acid + 1 to 3 oz. orange juice	9	
R. B.	15 mo.	Hypoplastic anemia; cold	8 oz. orange juice	3	
T. Q.	22 mo.	Acute herpetic gingivostomatitis	100 mg. ascorbic acid	6	
P. S.	4 mo.	Bronchopneumonia; otitis media	100 mg. ascorbic acid + 2 to 4 oz. orange juice	11	
R. B.	2 yr.	Acute herpetic gingivostomatitis	8 oz. orange juice daily	6	
M. G.	2 yr.	Perinephric abscess	100 mg. ascorbic acid	3	
E. Z.	2 yr.	Otitis media; spontaneous pneumothorax	100 mg. ascorbic acid	6	
B. C.	1 yr.	Pelvic abscess	8 oz. orange juice	4	

ADDED ASCORBIC ACID

Ascorbic acid was furnished to twenty-five children, either as extra orange juice or as ascorbic acid. The results in twenty-three of these cases are tabulated in Tables I and II. Table I lists the diagnoses, the dosages as ounces of orange juice or milligrams of ascorbic acid, and the number of days elapsing between the beginning of the treatment and the attainment of a plasma level of 0.7 mg. per cent or more. This is not necessarily a minimum value but merely records our observed interval. Table II lists the same data in those patients whose levels rose only to the borderline group (0.4 to 0.69 mg. per cent). The pa-

TABLE II

ADDED ASCORBIC ACID

ADMISSION LEVEL = 0 TO 0.39 MG. PER CENT; LEVELS RAISED TO BETWEEN 0.4 AND 0.69 MG. PER CENT

NAME	AGE	DIAGNOSIS	DOSAGE	NUMBER OF DAYS FROM BEGINNING OF ℞ TO LEVEL OF BETWEEN 0.4 AND 0.69	
		No Infections			
N. G.	11 mo.	Scurvy; prematurity	1 to 4 oz. orange juice + 50 – 100 mg.	5	
		Infections			
M. H.	8 mo.	Otitis media	50 mg. daily	5	(Same for 3 more days)
R. S.	5 mo.	Osteomyelitis of mandible	4 oz. orange juice daily	8	(Same level for 11 more days)
I. N.	6 mo.	Virus pneumonia	100 mg.	4	
I. C.	6 mo.	Prematurity; marasmus; diarrhea	75 mg.	38	(Same level for 18 more days)
W. H.	8 yr.	Compound fracture; gas gangrene; osteomyelitis of femur	100 mg.; 4 oz. orange juice	4	(Maintained level thereafter 17 more days)

tients with infections were all in active stages of their diseases. As noted before, no correlation with duration was attempted because of inaccurate histories.

One notes that, in these tables, seventeen are under 2 years of age, three are 2 years of age, and one, eight years of age. This unequal age distribution can be explained on the increased incidence of infection in these groups (Fig. 1) and a tendency on the part of the attending staff to prescribe added ascorbic acid for children in these age groups.

Two infants not in the tables were given ascorbic acid and responded poorly. A 6-week-old infant with pyloric stenosis received 50 mg. daily, but the plasma level did not rise over 0.25 mg. per cent over a period of eleven days. Perhaps a larger amount of vitamin or a longer observation period may have permitted this case to be classed in the borderline or normal classes. The other infant, 10 months old, with convulsions and interventricular hemorrhage, took less than one ounce of orange juice daily and ran a plasma level of from 0.13 to 0.37 mg. per cent for eleven days. Then 100 mg. of ascorbic acid were given daily, but in four days the level had not risen above 0.31 mg. per cent.

Of interest is the occurrence of four cases of manifest scurvy in children admitted within ten weeks during the winter of 1941-1942,

and one case of subclinical scurvy, whose diagnoses were confirmed by typical roentgenologic changes. In the children with the four manifest cases the daily fluctuation of the plasma level, as related to the ascorbic acid intake, is illustrated in Fig. 3, demonstrating the intimate relationship between the two. Disappearance of gingival hemorrhage, tenderness of extremities, and irritability, before appreciable plasma levels were reached, is also indicated.

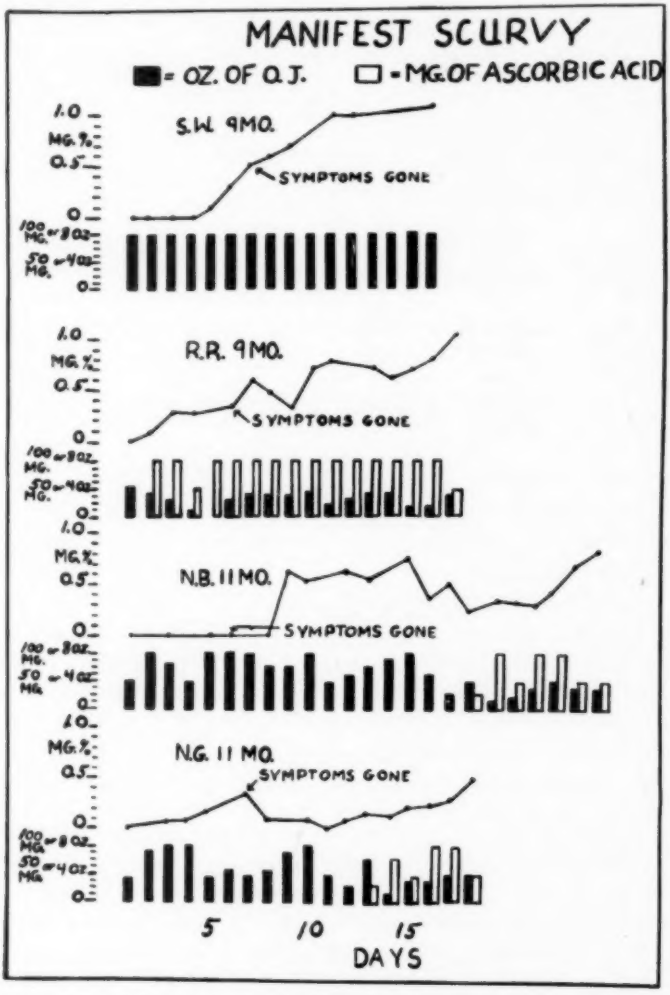

Fig. 3.—Relationship of plasma ascorbic acid levels to intake of ascorbic acid and disappearance of symptoms (gingival swelling, tenderness of extremities, irritability). Eight ounces of orange juice were prescribed in each instance, but only the actual amount taken is shown.

COMMENT

Examination of Fig. 1 suggests, as an evaluation of the nutritional status of Nebraska children in the lowest income group, that the infant under 12 months of age is not on an adequate intake of vitamin C. This may be magnified by the occurrence of infection in the infant up to and including the 2-year-old child. Otherwise there appears to be a rather even distribution of the normal (0.7 mg. per cent and above), borderline (0.4 to 0.69 mg. per cent), and low (0 to 0.39 mg. per cent) group in the various ages. A more significant inference on the status of vitamin C in these children may be obtained by pointing out that, on approximately 60 to 80 mg. per day as supplied by the ward diet, the following figures apply:

1. Sixty patients (40 without infection, 20 with infection) of the 64 entering with a level of 0.7 mg. per cent or more maintained that level during their hospital stay.

2. (a) Thirty-one patients (24 without infection, 7 with infection) of 42 entering with a level between 0.4 and 0.69 mg. per cent rose to 0.7 mg. per cent or more.

(b) Three patients (2 without infection, 1 with infection) of these 42 maintained their admission levels.

3. (a) Thirty-five patients (11 without infection, 24 with infection) out of 75 admitted with levels of 0 to 0.39 mg. per cent attained a level of 0.7 mg. per cent or more during their stay.

(b) Nine patients (4 without infection, 5 with infection) of these 75 achieved values between 0.4 and 0.69 mg. per cent.

Grouping these into a no infection group and an infection group the following facts emerge:

1. Of ninety-six patients admitted without infection, there were 80 (or 91 per cent) who attained or maintained a level of 0.7 mg. per cent or better, and 6 (or 6.2 per cent) who attained or maintained a level of from 0.4 to 0.69 mg. per cent. However, only 44.7 per cent of the whole group (43 of 96) entered with 0.7 mg. per cent or better. On the ward diet the levels of 25 per cent of the children in the no infection group (24 of 96) who entered with a level of from 0.4 to 0.69 mg. per cent rose to above 0.7 mg. per cent, and the levels of 11.4 per cent (11 of 96) who entered with a level of from 0 to 0.39 mg. per cent rose to above 0.7 mg. per cent.

Thus, assuming from 60 to 80 mg. of vitamin C to be an adequate intake in children without infections and a plasma level of 0.7 mg. per cent or more to be an optimal level, it appears that 36.5 per cent (35 of 96) of our children have been on a deficient intake prior to their entrance.

If we assume that a level of 0.4 mg. per cent and above is adequate, then only 11.4 per cent (11 of 96) of these children received inadequate

supplies of vitamin C. However, the ease with which a 0.7 mg. per cent level was attained in the relatively short hospital stays militates against this assumption.

2. Of 85 children admitted with infection, there were 51 (or 60 per cent) who attained or maintained a level of 0.7 mg. per cent or more and 6 (or 7 per cent) who attained or maintained a level between 0.4 and 0.69 mg. per cent. Of the remainder, 16 were given added C and responded (Tables I and II). The other 6 children represented short observation periods of from four to seven days and undoubtedly would have responded to added vitamin or a longer observation period.

In those admitted with infection, interpretation of adequate vitamin C is much more difficult because of the variables of accurate history, duration, type, and amount of activity of infection. Our cases, however, do suggest that intakes of from 100 to 150 mg. daily are adequate.

What of those children whose levels remained below 0.7 mg. per cent on an intake of from 60 to 80 mg. daily who were apparently healthy and without infection? Four such occurred in 96 patients observed. The first was a 22-month-old infant with idiopathic convulsions, observed over a period of nineteen days, the plasma levels varying between 0.3 and 0.64 mg. per cent. The second was an 18-month-old infant with a leukoma of the cornea, observed over eighteen days, the plasma levels varying between 0.55 and 0.62 mg. per cent. The third was a 5-month-old infant with meningocele, observed over seventeen days, levels varying from 0.7 mg. per cent on admission to 0.5 mg. per cent at the end of observation. These are probably adequate levels in these individuals. The fourth was a 4-year-old boy with a neurofibromatosis, observed over eleven days, the plasma levels varying between 0.1 and 0.23 mg. per cent. This last case is the only one of 96 apparently healthy children we would place in the category of a persistently low ascorbic acid level on a daily intake of from 60 to 80 mg. of vitamin C.

CONCLUSIONS

1. The distribution of high, intermediate, and low plasma ascorbic acid levels in Nebraska children of the lowest income group is presented.

2. On a daily intake of from 60 to 80 mg. of ascorbic acid, a level of 0.7 mg. per cent or more was attained in 81 per cent of children entering this hospital without infection, regardless of the entrance value.

3. The ease of attaining a value of 0.7 mg. per cent or more indicates that 36.4 per cent of our "healthy" children were probably on a diet containing less than from 60 to 80 mg. daily and that levels of from 0.4 to 0.69 mg. per cent may still be considered "borderline" for that group.

4. In two healthy infants entering with plasma levels in the borderline (0.4 to 0.69 mg. per cent) zone, 60 to 80 mg. of ascorbic acid daily did

not raise the level beyond 0.7 mg. per cent over observation periods of from eighteen to nineteen days. This is an incidence of two in ninety-six cases (or 2 per cent).

5. Of twelve children with infections, acute and chronic, from 100 to 150 mg. daily was adequate to raise the plasma level to 0.7 mg. per cent or more in eleven over periods of from three to twenty-one days.

6. Only one "healthy" child persisted in maintaining a low level of plasma ascorbic acid on an intake of from 60 to 80 mg. daily during eleven days of observation.

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PNEUMOTHORAX IN THE NEWBORN INFANT

Report of Three Cases

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IT IS probable that the number of clinically diagnosed cases of pneumothorax in the newborn infant is but a small percentage of the number that actually occurs. Davis and Stevens[1] in 1930 reported finding six cases in routine radiographic examination of 702 consecutive newborn infants, an incidence of approximately 1 per cent. In striking contrast, the *Quarterly Cumulative Index Medicus* lists but a few case reports each year, suggesting that the condition is unusual. This discrepancy is probably due to the fact that many cases are not extensive enough to present sufficient signs and symptoms on which to base a clinical diagnosis, or at least to warrant a radiographic examination which would confirm it.

With these points in mind, reports of three cases of spontaneous pneumothorax in the newborn infant recently seen on the newborn service of the St. Louis City Hospital are offered.

Case 1.—Infant S., a girl, was born Nov. 24, 1941, at 4:45 A.M., weighing 6 pounds, 13 ounces. Delivery of the infant was spontaneous of a 42-year-old white gravida vii. Presentation was L.O.A. Shortly before delivery a large amount of meconium was passed, and at birth the infant was coated with meconium. The umbilical cord was coiled once about the infant's neck. Cry was spontaneous, but respiration was labored. Mucus and meconium were aspirated from the oropharynx, and the infant was suspended by her feet. The respiratory excursion of the left chest was normal, but the right chest did not seem to move until that part of the chest was slapped smartly. Breath sounds were heard on both sides, with coarse moist râles bilaterally. Inhalations of 5 per cent carbon dioxide and 95 per cent oxygen were given with some improvement in respiration, but the infant was still slightly cyanotic when sent to the nursery.

During the morning, nurses noted that the infant became cyanotic at times. Physical examination at 11:30 A.M. showed suppression of breath sounds over the left chest posteriorly and distant heart sounds. Otherwise the examination was negative except for bilateral pes varus. Anterior posterior x-ray plate of the chest in the supine position showed bilateral pneumothorax much more marked on the left, with marked shift of the heart and other mediastinal structures on the right (Fig. 1). The film also showed spina bifida occulta in the lower cervical and upper dorsal vertebrae. Treatment consisted only of 5 per cent carbon dioxide and 95 per cent oxygen inhalations.

After the first day there was no cyanosis or other symptoms. On November 25 films showed some absorption of air from the pleural spaces with the heart in the midline. By November 26 there were no physical signs of pneumothorax, and films showed further but not complete absorption of air. The heart and other mediastinal

From the Department of Pediatrics, Washington University School of Medicine, and the St. Louis City Hospital. Presented at Staff Meeting of the St. Louis Children's Hospital April 3, 1942.

structures were in a normal position. On November 28 films showed persistence of a small amount of air in the left pleural space.

On December 2 the infant was discharged, weighing 6 pounds, 15 ounces. On Jan. 20, 1942, check-up physical examination was negative except for the pes varus. Films of the chest were negative.

Unfortunately, in this case lateral chest films were not obtained.

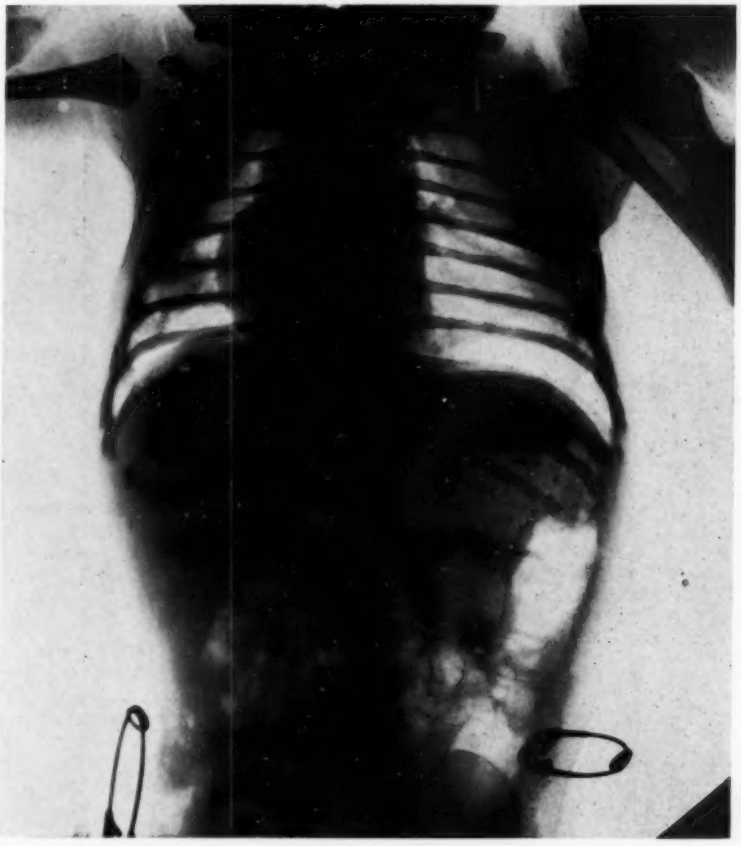

Fig. 1.—Bilateral pneumothorax much more marked on the left with marked shift of the heart and mediastinal structures to the right.

CASE 2.—Infant E., a girl, was born Dec. 14, 1941, at 5:40 P.M., weighing 5 pounds, 12 ounces. Delivery of the infant was spontaneous of a 24-year-old white gravida ii. Presentation was L.O.A. Cry was spontaneous, but the color was poor and respiration was labored. The latter was attributed to a large amount of tenacious mucus in the throat and nostrils. Removal of this material by suction relieved the respiratory difficulty, which, however, recurred one hour later, again necessitating the removal of mucus. Physical examination of the chest was negative.

On December 15 at 9:00 A.M. pediatrists were called to see the infant because of respiratory difficulty. Physical examination showed the heart sounds to be heard best to the right of the sternum. Otherwise, examination was negative except for

bilateral pes valgus and spastic upper extremities. An anteroposterior x-ray plate of the chest in the supine position showed left pneumothorax with marked shift of the heart and other mediastinal structures to the right (Fig. 2). Inhalations of 5 per cent carbon dioxide and 95 per cent oxygen were administered. At 4:00 P.M. physical examination showed impaired breath sounds on the left side laterally and hyperresonance of percussion note. There was no respiratory difficulty.

Fig. 2.—Left pneumothorax with marked shift of the heart and mediastinal structures to the right.

On December 17 physical examination showed heart sounds to be heard best to the left of the sternum, and films showed partial absorption of the left pneumothorax and possibly a small amount of right pneumothorax. The cardiac shadow was in the midline. A lateral view of the chest is illustrated in Fig. 3. On December 22 films failed to demonstrate air in any abnormal location. The heart and other mediastinal structures were in a normal position.

From this time on the infant's course was stormy with high fever. Later examinations indicated that the infant suffered from sepsis due to a nonhemolytic streptococcus with the focus of infection in an infected bilateral congenital hydronephrosis. The infant's course seemed to be little affected by intensive therapy. Eventually the infant recovered and slowly gained weight.

Subsequent mental development has been retarded. There was also arachnodactylia.

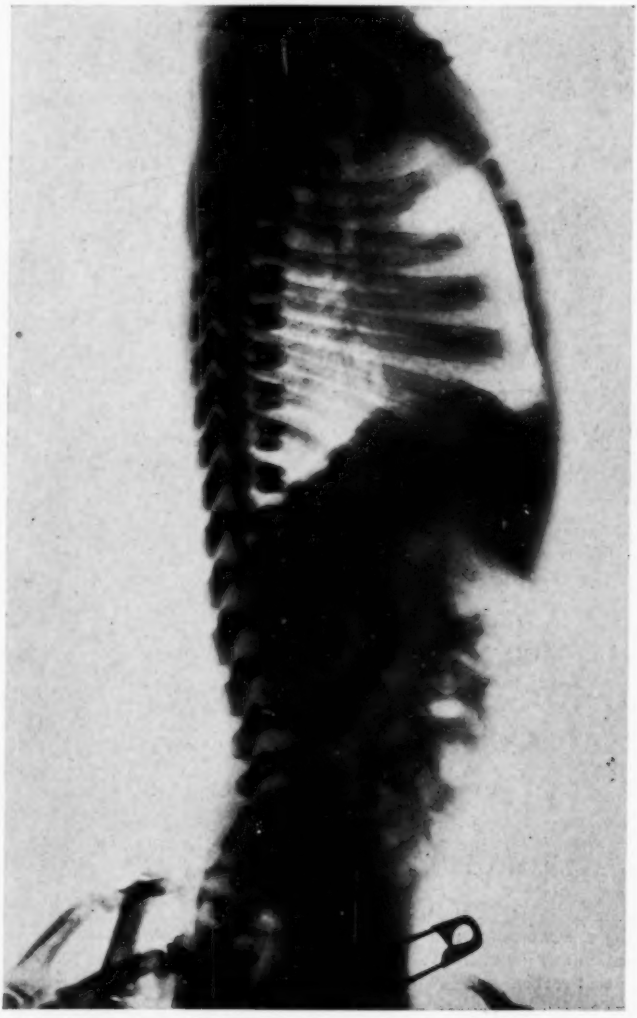

Fig. 3.—Left lateral view of left pneumothorax. Visualization of possible air in the mediastinum is interfered with by air in the pleural cavity.

CASE 3.—Infant G., a boy, was born May 3, 1942, at 9:32 A.M., weighing 6 pounds, 8 ounces. Delivery of the infant was spontaneous of a 38-year-old white gravida iii. Presentation was R.O.A. The mother was a pre-eclamptic. The umbilical cord was coiled three times about the infant's neck. Cry and respiration were spontaneous. The infant was examined at the delivery table by the obstetrician whose only positive finding was that breath sounds were not heard well. However, the infant was sent to the nursery in good condition.

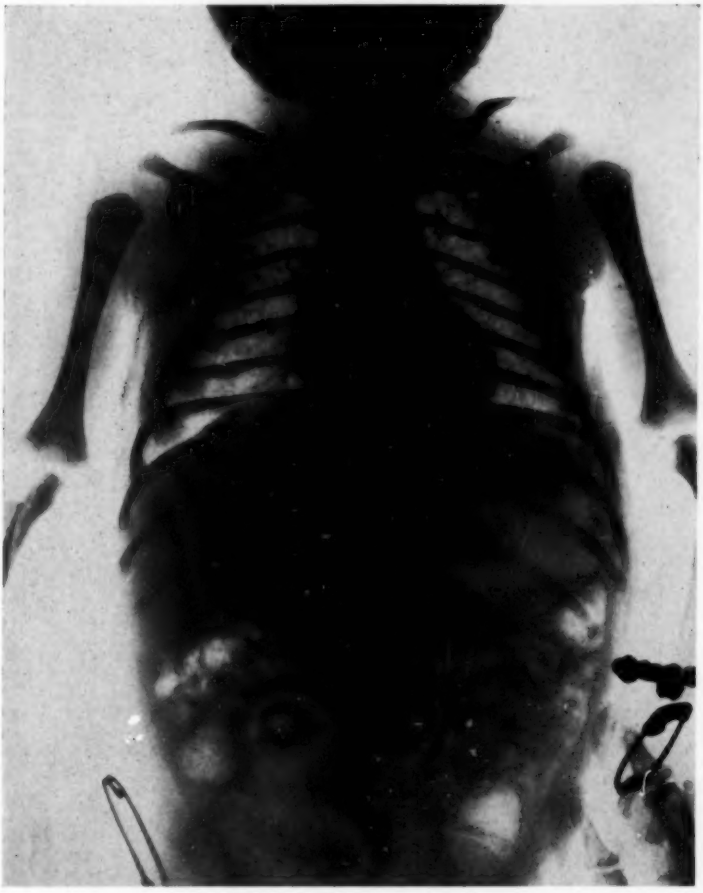

Fig. 4.—Right pneumothorax.

During the morning, nurses noted that the infant became cyanotic at times. Examination at 2:00 P.M. by a pediatrist showed only mild cyanosis which responded to 5 per cent carbon dioxide and 95 per cent oxygen inhalations. An anteroposterior x-ray plate of the chest in the supine position showed no abnormal findings.

Symptoms did not recur, despite the fact that on May 4 films showed a right pneumothorax (Fig. 4). On May 6 films showed partial absorption of the air.

A right lateral view taken the same day is illustrated in Fig. 5. On May 8 films failed to demonstrate air in any abnormal location.

On May 14 the infant was discharged, weighing 6 pounds, 7 ounces.

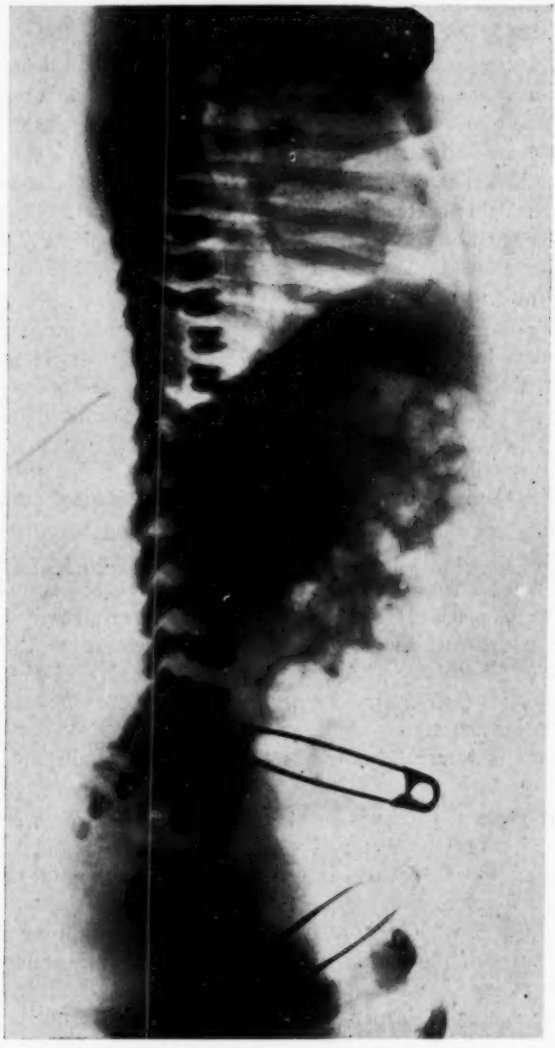

Fig. 5.—Right lateral view of right pneumothorax.

In reviewing these cases to obtain information as to the possible etiology, there are several points of interest. The passage of meconium before birth in the infant in the first case is evidence of intrauterine distress. In the infants in Cases 1 and 2 cry and respiration were spon-

taneous, but respiration was labored. In one infant (Case 1) this was attributed to meconium and mucus in the upper passageways and in the other (Case 2), to an abnormally large amount of tenacious mucus in the throat and nostrils. In two (Cases 1 and 3) the umbilical cord was coiled about the neck. In the infant in Case 3 the mother was a preeclamptic. In Cases 1 and 2 the infants showed congenital deformities; the infant in Case 1 had bilateral pes varus and spina bifida occulta, and in Case 2 the infant had bilateral pes valgus, spastic upper extremities, arachnodactylia, and later seemed mentally retarded. At the age of 2 weeks, the infant in Case 2 began a febrile course associated with bacteremia. That this bacteremia existed the first day of life is doubtful. Case 3 is very striking in that at the time the infant was cyanotic films did not show pneumothorax, yet after the cyanosis had disappeared pneumothorax was present.

In seeking the cause of any unexplained pneumothorax, two factors must be borne in mind: (1) a pathologic process of the respiratory tract, weakening its walls, and (2) overventilation or distention of the alveoli. Either or both of these may result in weakening the walls of the respiratory tract and contribute to a break in the continuity of the wall at one or more points. Either one alone, if sufficiently marked, might lead to the appearance of air outside of the normal pathways.

In pneumothorax of the newborn infant due to congenital deformities of the respiratory system, local trauma such as fractured ribs, or neonatal pulmonary infections, the pathologic process is the more important. However, in labored respiration with increased respiratory excursion secondary to obstruction due to tenacious secretions in the tracheobronchial tree (especially with a ball-valve mechanism and distal emphysema), atelectasis (especially with an area of compensatory emphysema), intracranial hemorrhage, and congenital heart disease, the factor of overdistention enters. Overzealous resuscitation should not be overlooked.

In recent years the experimental work of Macklin[2, 3] has emphasized the factor of overdistention and explained a probable relationship of pneumothorax to pulmonary interstitial emphysema and mediastinal emphysema. Macklin has shown, during overinflation of a portion of the lung of cats and rabbits, that air first passes through multiple and minute ruptures of the alveoli to spaces surrounding the finer divisions of the pulmonary blood vessels. From here the air travels along the perivascular spaces of larger and larger blood vessels until the mediastinum is reached. From there rupture of the mediastinal pleura into the pleural sac may be but one of several complications. The air can travel also to the interstitial tissue of the other lung, to the neck, along the great vessels through the diaphragm to the retroperitoneal space, and from there rupture the parietal peritoneum into the peritoneal sac, or along blood vessels to the groins to produce subcutaneous emphysema

In the case of the newborn infant, whether the air passes directly from the respiratory tree through the interstitial tissue of the lung to rupture the visceral pleura to reach the pleural space or travels the more circuitous route described by Macklin would seem to depend on the relative importance of the two etiologic factors in an individual case. A third possibility is that once the air reaches the interstitial tissue of the lung, part of it may rupture the visceral pleura to produce a pneumothorax and part may travel along the perivascular spaces to reach the mediastinum. However, since the collapse of the lung produced by the pneumothorax would tend to compress the perivascular passageways to the mediastinum, it is unlikely that any considerable amount of mediastinal emphysema would be produced. This has led Macklin to suggest artificial pneumothorax as a therapeutic procedure in mediastinal emphysema.[3] A fourth possibility is that some local pulmonary pathologic process may result in a tension pneumothorax. A tension pneumothorax can cause mediastinal emphysema.[4, 5]

The diagnosis of pulmonary interstitial emphysema is difficult to make and requires radiographic confirmation. The outstanding symptoms of mediastinal emphysema, dyspnea and cyanosis, are caused by the mechanical effect of the abnormal presence of air on the great vessels, particularly the veins.[6] The heart sounds are distant. In adults a crackling crunching sound synchronous with the heartbeat may be present, and precordial pain may be an outstanding complaint.[7] The signs and symptoms leading to a diagnosis of pneumothorax need no special comment except that in those cases in which the factor of overventilation and distention is the more important, and which are presumably more likely to be preceded by mediastinal emphysema, the respiratory difficulty is the cause of the pneumothorax and not vice versa. Actually, pneumothorax may not necessarily even be one of the complications, and, if it should be, it may be accompanied by alleviation of symptoms,[8] probably because of consequent lowered tension in the mediastinum. This may explain why the cyanosis in the infant in Case 3 subsided with the appearance of the pneumothorax. Artificial pneumothorax has, as already mentioned, been suggested as a therapeutic procedure for mediastinal emphysema because collapse of the lung would tend to arrest the train of events increasing the collection of air in the mediastinum.[3] Such might well be tried if a radiographic localization of a unilateral area of pulmonary interstitial emphysema or chest pain indicates which lung is the offender.

Final convincing proof of these cases rests with the radiographic findings. In many cases even an x-ray diagnosis of pulmonary interstitial emphysema is difficult. In most cases an x-ray diagnosis of pneumothorax is easy enough. An x-ray diagnosis of uncomplicated mediastinal emphysema should offer little difficulty. An anteroposterior or posteroanterior view of the chest would show the air. A characteristic paracardiac halo of air has been described.[9] A lateral view of the chest

should be conclusive. However, should mediastinal emphysema be complicated by pneumothorax and, as the elastic lung collapses, a high percentage of the air in the mediastinum thus be removed, the anteroposterior or posteroanterior views might not be conclusive, and the lateral view would be interfered with by air in the pleural sac.

The treatment of pneumothorax in the newborn infant should be conservative, utilizing carbon dioxide and oxygen mixtures, oxygen alone, and stimulants. Aspiration should be reserved for the more severe cases. In cases accompanied by mediastinal emphysema, the cause of the initial respiratory difficulty should be considered. Aspiration of the mediastinum should be attempted only in the infants failing to respond to the simple measures mentioned above.[8, 10]

SUMMARY

1. Three cases of pneumothorax in the newborn infant are presented.

2. Two etiologic factors of pneumothorax in the newborn infant are emphasized, and the probable mode of action of each examined.

3. The diagnosis, radiographic findings, and treatment are outlined.

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THE TREATMENT OF TONSILLITIS, PHARYNGITIS, AND GINGIVOSTOMATITIS WITH THE BISMUTH SALT OF HEPTADIENECARBOXYLIC ACID IN COCOA BUTTER SUPPOSITORIES

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THE effective use of bismuth as an antisyphilitic agent would logically suggest its adaptation to other infections, particularly those of spirochetal or spirillar origin. Bismuth has shown itself effective in cases of streptococcal tonsillitis as well,[1] besides possessing analgesic properties. Monteiro,[2] in 1923, inaugurated the use of bismuth in infections of the buccal cavity by successfully healing the ulcers in Plaut-Vincent's type of tonsillitis. This was accomplished by two bismuth injections at an interval of twenty-four hours. Subsequent treatment of catarrhal, follicular, and parenchymatous types of tonsillitis yielded similar uniformly favorable results. Marinho,[3] who confirmed this work in 1926, went so far as to classify tonsillitis into two types; namely, those which do and those which do not respond to bismuth therapy. Mangabeira-Albernaz[4] used 10 per cent acid tartro-bismuthate of potassium locally in an extremely painful and serious case of Vincent's angina with startlingly brilliant results. Rastelli[5] cured ten patients with tonsillitis following Monteiro's method of injecting 0.05 Gm. of bismuth, with repetition if necessary, in from twenty-four to forty-eight hours. Of his patients, five responded within three days, and one each on the fourth, fifth, sixth, and eighth days. One patient with ulceronecrotic tonsillitis (Plaut-Vincent) required additional neosalvarsan.

The rapidity of the disappearance of symptoms and signs is stressed by most observers. Stiehr[6] reported a drop in temperature to normal within twelve to twenty-four hours in his treatment of 152 patients. Koehler,[7] treating sixty-one children, observed that the earlier in the course of the ailment bismuth is administered, the more rapid the defervescence. Monteiro[8] observed the disappearance of follicular exudate in the majority of his patients within twenty-four hours. Boese,[9] in 140 patients, noted the effectiveness of bismuth was most marked in the most extensively involved cases; the more profuse the exudate and the deeper the necrosis, the more efficient the treatment. Imhof,[10] besides noting prompt relief of pain, also observed disappearance of follicular purulent exudate from the tonsils in twenty-four hours. Zeidler,[11] in 112 patients, also found that the exudation on the tonsils disappeared twenty-four hours after treatment was begun. Vaz de Mello,[12]

The suppositories used in the patients in this series of cases were "Infant Size Analbis" suppositories, each containing 0.0675 Gm. bismuth salt of heptadienecarboxylic acid (0.0225 Gm. metallic Bi) in cocoa butter base; produced by Specific Pharmaceuticals, Inc.

reporting on 130 patients, obtained cures in seventy-two hours—in the majority, within forty-eight hours. Rojas and Nijensohn,[13] in over 100 patients, and Berberich,[14] in 50 patients, report prompt relief of pain after the use of bismuth, together with a reduction in the expected duration of the ailment. Errecart[15] and Nuernbergk[16] observed relief of pain within four hours. There is general agreement with the findings of Koehler,[7] that the average duration of tonsillitis is reduced from six to eight days to from twenty-four to forty-eight hours. Galewski,[17] reporting on sixteen patients treated at the French Hospital in London and twelve ambulatory patients, noted a drop in temperature in twenty-four hours, relief of dysphagia in from seven to ten hours and, in Vincent's angina, in from sixteen to twenty-four hours after injections of sodium iodobismuthate. He emphasizes the "rapid absorption and penetration of the tissues, especially lymphatic tissues such as the tonsils, while toxic effects are obviated by rapid elimination." Lewis[18] treated forty patients, over a period of six months, who showed enough evidence of tonsillar fusospirochetal infection to justify the use of "specific treatment." Either arsenicals or bismuth injections usually produced prompt improvement. He felt that bismuth was the treatment of choice in the majority of patients with severe tonsilitis; the temperature usually became normal in twenty-four hours, and there was marked subjective relief in twelve hours, while exudate and swelling showed considerable clearing within twenty-four hours. He used bismuth subsalicylate by injection but expressed the hope that the necessity for injections might be obviated by finding an oral bismuth preparation that would prove effective.

Bismuth has been used in a form probably easier of administration than an oral medicament and as effective as the injections. An especially absorbable and easily utilized form containing the bismuth salt of heptadienecarboxylic acid in cocoa butter was used by Kowarz[19] in thirty-two patients with angina, ulcerous angina, and some cases of upper respiratory infection, with complete clearing up of symptoms after seventy-two hours. Alpar and Weisz[20] similarly treated twenty-six patients, twenty-one of whom could be followed up. Three of these had peritonsillar infiltrations when first seen. Twenty of the twenty-one patients showed retrogression of inflammatory symptoms and tonsillar exudate within thirty-six hours; one went on to the development of peritonsillar abscess which was incised and healed uneventfully. Orso treated fifteen patients with ulcerous stomatitis by the daily use of suppositories.[21] Treatment was begun in the patients with average cases on the third or fourth day of the illness. High fever, hemorrhagic, coated, ulcerated gums, intense pain, and swollen cervical nodes began to improve on the first day; objective signs were definitely less on the fourth day with complete recovery on the seventh day. Of eleven patients with Plaut-Vincent's angina also thus treated, recovery occurred on the fifth day in ten, six of whom also had glycerin-salvarsan painted

locally without distinguishable difference from those not so treated. One patient with a refractory case recovered on the twenty-first day after a great variety of additional treatments.

There is, of course, a spontaneous variability in the course of tonsillitis which makes a valuation of therapy difficult. However, even catarrhal types last about three days or more, and severer types average about eight days. The usual invaders are predominantly streptococci, with some staphylococci, 96 per cent of 1,022 patients in cases noted by Monteiro[2] having the streptococcus as the causative organism. The fusospirochetal infections, e.g., Vincent's angina, are of much longer duration. Gingivostomatitis may prove especially troublesome and refractory, dragging along alarmingly for weeks with engorged, hemorrhagic gums, loosening of teeth, severe pain, foul breath, and often serious constitutional reactions. In view of the results reported above, the gratifyingly favorable influence of bismuth opens up a promising new avenue of approach to the treatment of infections of the buccal cavity. However, intramuscular injections, since they may produce pain, induration, and even abscess formation, are especially disagreeable in children. Bismuth that can be administered in the form of suppositories would obviate these objections, providing there was no local irritating action on the tissues of the anus and the lower bowel. That no ill effects result has been demonstrated by experiments on rabbits, using cocoa butter suppositories as the medium for introducing bismuth (as the salt of heptadienecarboxylic acid). Within seventy-two hours after insertion of even three suppositories, no bismuth was found in the posterior three inches of the large intestine or anus. As for toxic effects, when as much as twenty-five times the dose indicated by Kollmer, Brown, and Rule[24] as antisyphilitic was used, there were no toxic reactions noted. Besides the ease of administration, the use of absorbable bismuth suppositories avoids the difficulties encountered in attempting to force medication through an already inflamed area by the peroral route and also avoids the gastrospasm and vomiting that frequently occur with both loss or waste of medication and aggravation of the local condition.

During the past six months, thirty-two patients with tonsillitis, pharyngitis, and gingivostomatitis (Vincent's) were treated with an absorbable bismuth salt of heptadienecarboxylic acid in cocoa butter suppositories. The following twelve cases are here detailed as typical of the series, representing a diversity of complaints and findings, all of which were similarly amenable to the treatment instituted.

CASE 1.—H. G., male, 7½ years of age, was seen May 14, 1942, with a complaint of racking cough and fever of one and one-half days' duration, with a range between 100.5 and 102° F., and some difficulty in swallowing.

First Day.—Examination revealed a well-developed youngster somewhat flushed and uncomfortable. He had a markedly congested pharynx, enucleated tonsils and adenoids with a small left tonsillar tab, sprinkled with slight exudate. There was a postnasal drip of thick mucopurulent material. The upper and lower gums were markedly congested with two small ulcerated areas over the right mandibular

premolar and left mandibular lateral incisor. The breath was distinctly foul smelling. Both subtonsillar nodes were enlarged and tender. The temperature range was between 100 and 101.8° F. One bismuth suppository was administered.

Second Day.—Practically no change. The ulcerated areas on the gums gave a punched-out appearance, and the gums were slightly more puffed. The second suppository was given.

Third Day.—General condition was excellent, temperature remained below 101° F. The gums were almost completely healed, the puffiness and congestion were much less marked. The pharyngeal congestion was almost completely gone, and exudate on the tonsillar tab had disappeared. The anterior cervical and subtonsillar nodes were still palpable but not as tender, but the postnasal drip persisted and the cough therefore had abated but little.

Fourth and Fifth Days.—The temperature remained below 100° F. except for one upward shoot to 102°F. of short duration (about six hours), apparently due to the nodes. The throat and the gums were practically normal.

Sixth to Ninth Days.—The postnasal drip, the cough, and the nodes receded, and the low-grade temperature (never above 100° F.) receded to normal.

Previous attacks of pharyngitis usually lasted from six to ten days (when uncomplicated, as in this case, by gingivitis and adenitis).

CASE 2.—J. G., male, 4 years of age, was seen on Aug. 14, 1942, and complained of severe sore throat, pains on both sides of the neck, difficulty in swallowing, malaise. There was fever of 101° F. to begin with, which rose to 104° F. by evening.

First Day.—Examination revealed enlarged, congested, cryptic tonsils, with follicular exudate almost completely hiding tonsillar tissue. The uvula was swollen, and the posterior pharyngeal wall was deeply injected. There were enlarged tender anterior cervical nodes. Temperature range was between 101 and 104° F. One bismuth suppository was administered.

Second Day.—Temperature dropped to 99.2° F., then gradually to normal. All subjective symptoms disappeared, the swollen tonsils receded, the follicular exudate almost completely disappeared. No further medication was used. Previous attacks lasted from five to eight days.

Third Day.—Patient completely normal.

CASE 3.—S. S., male, 2½ years of age, was seen on Aug. 17, 1942, after complaining for one day of sore throat, loss of appetite, inability to swallow, and a fever of 104° F.

First Day.—Examination revealed an acutely ill child, with flushed face; respiration, 28; pulse, 146. There was marked crankiness and discomfort. The pharynx was congested, the tonsils markedly enlarged and engorged, meeting in the midline on gagging. There was an extensive follicular exudate on both tonsils. The anterior cervical nodes were tender and slightly enlarged. One bismuth suppository was administered.

Second Day.—The temperature which had ranged between 102.4 and 104.4° F. on the preceding day fluctuated between 101 and 103° F. The constitutional symptoms were much less marked, the malaise, crankiness, and inability to swallow being definitely less troublesome. The exudate on the tonsils was somewhat increased, almost covering them, but the engorgement of the tonsils was less, so they appeared smaller. Another suppository was given.

Third Day.—The temperature dropped to a range of between 99 and 100.2° F. The exudate on the tonsils had almost completely disappeared, the congestion of the pharynx and the engorgement of the tonsils were almost gone, and the cervical nodes were just palpable but no longer tender.

Fourth Day.—Temperature, normal; throat, normal. All symptoms were gone. Patient had had three previous attacks of (follicular) tonsillitis lasting from six to ten days, with only gradual recession in symptoms for another few days thereafter.

CASE 4.—D. R., female, aged 11 years, was seen on Aug. 23, 1942, with complaints of abdominal pain, pains in the side of the neck, and dryness in the throat.

First Day.—Examination revealed a markedly congested pharynx and uvula (tonsils had been enucleated); there were palpable, tender anterior cervical nodes. Abdominal examination was negative. There was an apical systolic murmur not transmitted. Temperature was 102° F. One bismuth suppository was administered.

Second Day.—Urinalysis was negative. There were no complaints. Temperature did not exceed 99.6° F., pharyngeal congestion was less, and swelling and tenderness of anterior cervical nodes had receded. A second suppository was not deemed necessary.

Third Day.—The condition had cleared up completely, temperature was normal for eighteen hours past, apical systolic no longer audible.

CASE 5.—M. K., female, aged 12 years, was seen on Aug. 23, 1942, and had a temperature of 101.5° F., the evening of her return from camp. The main complaints were headache and irritation in the throat with malaise and some dryness in the nose. There was also some abdominal pain.

First Day.—There was marked pharyngeal congestion with engorged vessels in the fauces and on the uvula. There were no tender or palpable nodes. Temperature was 101.5° F. One bismuth suppository was administered.

Second Day.—Started with temperature of 100° F. with recession to normal by nightfall. There were no complaints and no second suppository was necessary.

Third Day.—Completely normal.

CASE 6.—I. L., male, 5½ years of age, was seen on Aug. 26, 1942. The patient had been cranky and anorexic for two days, when the mother took his temperature and found it to be 101.4° F. It went as high as 103° F. when he was first seen. He also complained of intermittent abdominal pains.

First Day.—Examination revealed a congested pharynx, uvula, and faucial pillars. There was clean enucleation of the tonsils but a moderate postnasal drip. The nasal mucosa was congested and the gums markedly engorged, especially over two loose upper central incisors. The subtonsillar nodes were enlarged and tender. Temperature ranged between 101 and 102.6° F. One bismuth suppository was administered.

Second Day.—The subtonsillar nodes were considerably larger and more tender; there were aphthae on the mucosa of both sides of the buccal cavity and small punched-out ulcerations on the gums over the maxillary right canine and mandibular left premolar and also on the soft palate. The gums were markedly puffed and congested, and there was a foul, heavy odor to the breath. The pharynx was markedly congested and the uvula swollen and injected. The temperature range was between 101½ and 103½° F. A second suppository was administered and an ice collar ordered for the neck.

Third Day.—The temperature range was the same and the cervical nodes still large and tender. However, the aphthae and the small ulceration over the right maxillary canine were gone. The gums, however, were spongy and filled with blood, extending down over the teeth and almost completely covering them. The pharyngeal, faucial, and uvular congestion were somewhat less. All subjective complaints were gone.

Fourth Day.—The congestion of the gums, pharynx, and uvula continued to recede; the cervical nodes were smaller and they were less tender. The temperature was between 100 and 101.2° F.

Fifth Day.—Continuing recession; temperature, between 99 and 100° F.

Sixth Day.—Temperature, normal; gums almost normal; nodes no longer tender though still palpable.

Seventh Day.—Completely normal.

Before tonsillectomy this youngster ran temperatures of between 102 and 104° F. for from ten to twelve days, even with sulfonamide therapy, and had lingering low-grade temperatures up to 100.5 and 101.5° F. for as long as one month subsequently. After tonsillectomy six months ago, he had an uncomplicated attack of pharyngitis lasting ten days, with low-grade temperature (up to 100° F.) for one week thereafter.

CASE 7.—E. L., female, aged 3 years, was seen on Aug. 29, 1942, and complained of severe coughing spells, anorexia, and dysphagia. Temperature was 101.5° F. during the night and rose to 102.6° F. in the morning. At the time of examination it was 103.2° F.

First Day.—Examination revealed a pair of markedly enlarged congested tonsils with scattered follicular exudate. There was a thick, mucopurulent, postnasal discharge covering the posterior pharynx. There was a beet red streak along the soft palate. The anterior cervical nodes were enlarged and tender. The posterior pharynx and tonsils were cleansed by argyrol swabbing, and one bismuth suppository was administered.

Second Day.—Temperature range dropped to between 100.2 and 101.4° F. from previous day's range of between 101 and 103.2° F. The difficulty in swallowing and angina disappeared. The tonsillar congestion abated and the tonsils were definitely smaller; the exudate did not return. The cervical nodes, though still large, were no longer tender. No further medication was used.

Third Day.—Gradual recession to normal; temperature range, between 98.4 and 99.6° F. Tonsils were hypertrophied but no longer congested; throat, clean. Previous attacks of tonsillitis ten days to four weeks with bronchitis and invariable sequelae.

CASE 8.—M. S., female, aged 6 years, was seen on Sept. 5, 1942. The history of this patient's ailment dated back three weeks, when the child complained of "stomach aches" on and off during the day. She was apparently well the following day. Four days later she again complained of stomach ache and ran a temperature of 101° F. She received medication for "intestinal grip" but ran temperature up to 103° F. for another three days, with eventual disappearance of the abdominal cramps. Two days later the temperature again rose up to 103° F. and irregular fluctuations between 99° and 103° F. continued for about one week, during which diagnoses of "intestinal infection," "probable appendicitis," and "intestinal flu" were made. The temperature dropped after that and stayed between 99 and 100° F. until the day I was called when it had again reached 103.2° F. The complaint at that time was again abdominal cramps. Throughout, the mother had noted what she termed a "foul bilious odor" from the child's breath.

First Day.—The child was somewhat thin, pale, and apparently acutely ill. The pharynx and uvula were markedly congested. There was a postnasal drip of mucopurulent material. The gums were intensely congested, markedly swollen, spongy, and ballooned up with blood, extending down over the teeth and obscuring them almost to their cutting edges. There was a foul, heavy odor from the breath. No ulcerations were present. The anterior cervical nodes were enlarged and tender. The abdominal and rectal examinations were negative. A urinalysis revealed no pus or other abnormality. One bismuth suppository was administered.

Second Day.—The condition remained about the same. There had been a drop in temperature in the morning but it went back up to 103.4° F. A second suppository was administered.

Third Day.—The temperature dropped to normal, the pharyngeal congestion was much less marked, the tenderness in the cervical nodes was much less, the abdominal pain disappeared, and there were no further complaints.

Fourth to Eighth Days.—The pharyngeal congestion disappeared completely on the fourth day, but the swollen spongy congested gums receded only gradually until completely normal. All subjective symptoms and the fever did not return after the third day.

CASE 9.—S. K., male, aged 21 months, was seen on Sept. 10, 1942. The child was perfectly well the preceding day, suddenly felt hot to the touch. Several hours later, he refused food, vomited when forced, cried when neck was touched, and was very cranky. Temperature was 103.2° F.

First Day.—Examination revealed an acutely ill child, flushed, irritable. Tonsils were enlarged, markedly congested with scattered follicular exudate; uvula swollen; posterior pharyngeal wall congested; slight postnasal drip; subtonsillar nodes enlarged and tender. The temperature range was between 101.8 and 103.2° F. One bismuth suppository was administered.

Second Day.—Temperature gradually dropped to normal, range being between 98.2 and 99.6° F. Both signs and symptoms completely disappeared. Previous attacks of tonsillitis lasted from eight days to three weeks, with involvement of nodes, ears, and bronchial tubes as sequelae.

CASE 10.—M. S., female, aged 14 years, was seen on Sept. 13, 1942. The patient developed cough, running nose, and a temperature of 101.5° F., with gradually increasing malaise despite home remedies. The cough became worse; it was racking and nonproductive. By 10 P.M. the next evening, there was headache, constricted feeling in the throat, difficulty in swallowing, pain on both sides of the neck, excessive drowsiness, and a sudden spurt in temperature from the previous range of between 100.4 and 102° F. to 104° F.

First Day.—Examination revealed a crimson red congestion of the posterior pharyngeal wall and similar congestion of the posterior faucial pillars. The uvula and soft palate exhibited an intense reddening. The nasal mucosa was dry. The cervical nodes were not involved. The chest was congested and a few moist, scattered râles were audible anteriorly over the left lobe. Temperature range was between 102.8 and 104° F. Menstruation had just started. One bismuth suppository was administered.

Second Day.—The patient was markedly relieved of all symptoms. There was a drop in temperature to 101.2° F. and a further decline during the day to 100.2° F. The headache was gone, the drowsiness gone, and the difficulty in swallowing much less. Second suppository was given.

Third Day.—The temperature was back to 102.2° F., the cough was a little worse than on the previous day, and there was again some complaint of pain on swallowing. Râles were still present in the upper lobes on both sides. A third suppository was administered with a rapid drop in temperature during the day to normal. The general condition improved, and the cough receded. The pharyngeal congestion was almost completely gone.

Fourth Day.—Temperature, normal; condition completely cleared up, including the racking cough.

CASE 11.—M. Z., female, 27 months of age, was seen Sept. 15, 1942, with the complaint that she had been running fever for three days, highest in the evening, up to 103° F. three days before and up to 102° F. since then. There was a

slight cough, usually on feeding, and a slightly running nose. There was marked irritability and complete anorexia.

First Day.—Examination revealed a somewhat poorly developed and ill-nourished child. The throat was congested, the tonsils enlarged and congested, the uvula injected, the anterior cervical nodes palpable and tender. Urinalysis showed a faint trace of albumin and 18 to 20 white blood cells. The temperature was 99.4° F. at the time of examination and rose to 101° F. in the evening. One bismuth suppository was administered and an iron tonic in vitamin B complex given.

Second Day.—There was a complete recession in symptoms, the crankiness was entirely gone, and the child ate two full meals for the first time in weeks. The highest temperature for the day was 99.6° F.

Third Day.—Completely normal.

CASE 12.—G. S., male, aged 7 years, was seen Sept. 16, 1942, with the complaint of severe headache, nausea, and abdominal pain. There was difficulty in turning the head and bending the neck. Later, pain on swallowing and constriction in the throat developed. This patient had had attacks of tonsillitis lasting usually from six to ten days. Previously he was treated by me for acute follicular tonsillitis with sulfathiazole. He was cured in five days then, but an accompanying cervical adenitis persisted four days longer.

First Day.—Examination revealed an acutely ill child, markedly irritable and uncomfortable. There was marked pharyngeal and uvular congestion. Both tonsils were large, cryptic, and swollen, the left tonsil extending as far as the uvula and exhibiting an angry reddening. The anterior cervical nodes were enlarged and tender on both sides. The temperature, which started at 104.2° F., had dropped to 102.4° F. upon the administration of aspirin. An ice collar was ordered and a bismuth suppository administered.

Second Day.—The headache, pain in the throat, difficulty in bending the head, and other subjective symptoms had disappeared. The temperature remained below 101.4° F. The tonsillar swelling was less marked and the congestion much less. The cervical nodes were also markedly less tender.

The temperature returned to 104° F. later in the day and the headache with it. Pain in the throat was completely gone, and, despite the fever, the child remained fairly comfortable and did not appear acutely ill. Another suppository was administered.

Third Day.—Began with temperature of 104° F. at 7 A.M. There were no complaints, however, except tenderness to touch of the anterior cervical nodes. By midday the temperature had dropped precipitately to 100.2° F. The parents, who were both physicians, noted complete absence of tenderness of the cervical nodes and considerable recession in the swelling. The markedly swollen tonsils had receded as well, and the pharyngeal and tonsillar congestion were almost completely gone. Examination later in the afternoon verified these earlier findings with continuing retrogression to normal of the temperature and the local throat condition. The cervical nodes were only one-half their former size and the pain and tenderness completely gone.

Fourth Day.—Complete return to normal; throat clean; tonsils no longer swollen; cervical nodes back to normal size.

To determine properly the effectiveness of the medication in patients in the above cases, it would be noted that what is termed "first day" denotes the first day the patient was seen. "Second day," therefore, denotes the first day of actual treatment, so that the end of the "second day" corresponds to the first twenty-four hours of treatment. On examining the twelve patients whose case reports are recorded here, it may thus be noted that there was a drop in temperature within twenty-four

hours, with recession to normal by forty-eight hours in most of the patients; subjective symptoms began to disappear within twenty-four hours and were gone in forty-eight hours; and signs of local improvement appeared within twenty-four hours and were complete within forty-eight hours, with an exception in some (not all) of the cases in which the patients had gingivostomatitis of longer standing and some (not all) in which the patients' conditions were complicated by respiratory involvement or adenitis. The condition of the remaining twenty patients of the series most closely resembled that of the one in Case 2. Temperatures dropped within twenty-four hours and were completely gone in most cases by thirty-six hours. Pains in the throat and nodes, dysphagia, malaise, and discomfort were relieved in twenty-four hours and completely gone in the majority of instances by thirty-six hours, and the local inflammation and exudate, when present, disappeared within forty-eight hours. Even cervical nodes responded with surprising rapidity, particularly tenderness. No patients were encountered in which any noticeable increase in swelling or tenderness developed after treatment was begun; neither were any complications of the initial findings seen. All concomitant symptoms also, such as cramps, vomiting, listlessness, drowsiness, dry or running nose, whether reflexly caused, or directly by the local inflammation, underwent prompt regression with the primary condition.

In my thirty-two patients the bismuth suppositories proved almost specific in their action on infections of the throat and gums. The response in exudative types of infection with marked systemic, as well as local, reaction responded especially rapidly. This experience is particularly gratifying because of the frequent inability of sulfonamides in similar cases to produce results approaching those obtained with bismuth. The frequency of toxic symptoms, the necessity for watchful control, the development of sulfonamide-fastness and of subsequent asthenia following the use of the sulfonamides are further drawbacks to their general use in conditions seen as frequently as tonsillitis. Rhoads and Afremow,[25] in a series of well-controlled cases of sore throat and tonsillitis, found that systemic treatment with sulfonamides did not yield expected results; neither, in fact, was the course of the disease shortened as compared with controls treated symptomatically. Actually asthenia and convalescence preceding full recovery were even more prolonged than after symptomatic treatment. The patients treated with bismuth suppositories were completely well, symptomatically and constitutionally, within a day after disappearance of complaints, usually directly following defervescence.

SUMMARY

1. Thirty-two patients with tonsillitis, pharyngitis, and gingivostomatitis, case reports of twelve of whom are cited in detail, were treated

with suppositories containing the bismuth salt of heptadienecarboxylic acid.

2. Subjective symptoms disappeared within twenty-four to forty-eight hours after treatment was begun.

3. Temperature dropped within twenty-four hours and was gone in from thirty-six to forty-eight hours in most cases.

4. Signs of local improvement appeared within twenty-four hours.

5. In patients in whom attacks of a similar nature had occurred, whatever form of treatment was used, the duration of the illness was much longer than in the same individual treated with bismuth.

6. No more than two suppositories at twenty-four-hour intervals were required in all but one patient.

7. There were no local ill effects from the use of the suppositories.

8. There were no toxic reactions to bismuth.

CONCLUSIONS

1. The use of suppositories containing the bismuth salt of heptadienecarboxylic acid is recommended in the treatment of tonsillitis, pharyngitis, and gingivostomatitis.

2. It has the advantage over other methods of treatment, including the sulfonamides and arsphenamines, because of (a) the ease of administration, (b) the freedom from danger of toxic reactions, (c) the sparing of the sulfonamides for conditions where their specificity and definite indications more strongly require their use, and (d) the avoidance of production of sulfonamide resistance or sensitivity by their use in conditions where another medicament of proved equal or greater value is available.

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THE SANATORIUM METHOD FOR THE CARE OF RHEUMATIC HEART DISEASE IN CHILDREN

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SANATORIAL care as a form of therapy in the management of rheumatic disease in children has received ever-growing comment in medical discussions in the past few years. No clear-cut concept of the meaning of sanatorial care has as yet been formulated. Does a sanatorium in the accepted sense meet the requirements of the management of rheumatic disease? Are certain modifications in the routine essential, and are such modifications fundamental? What medical policy should govern sanatorial care with regard to type of cases admitted, duration of stay, therapeutics, education, form of activity, etc.? These and many related questions have thus far remained unanswered.

It is the purpose of this paper to describe a sanatorium for children with rheumatic disease. The medical policies governing this institution evolved on the concepts that the active phase of rheumatic disease in children is of much longer duration than the clinical signs would seem to show; that usual clinical and laboratory diagnostic criteria of acute rheumatic infection fall short in a great many cases of active rheumatic disease; that the so-called subclinical phase of acute rheumatic disease deserves as much therapeutic consideration as the well-known acute rheumatic arthritis or carditis; that the function of the sanatorium is to attempt to prevent further cardiac damage by active treatment of acute and subacute rheumatic infection; and that both clinical and subclinical phases of rheumatic active disease are part of the acute episode. The sanatorium was thus built upon the recognition that rheumatic disease is an acute disease of long duration punctuated by periods of arrest of variable duration. Each active episode is an acute phase and deserves as much therapeutic attention as any other acute phase, however mild the clinical manifestations may be.

The institution consists of six newly constructed brick buildings, each with a capacity of twenty-five beds. These buildings are arranged in a complete circle and are connected by overground and underground corridors. The architectural lay-out provides the maximum of light, air, and sunshine. Four are devoted to ambulatory children who have recently recovered from a clinically active rheumatic episode. Each is a self-sufficient unit, completely equipped to meet all the daily needs of these children.* Of the remaining two buildings, one is built and

From the St. Francis Sanatorium for Cardiac Children, Roslyn, N. Y.

*Each of these buildings has two dormitories with twelve beds each; ample bathroom facilities leading from each of the dormitories; one isolation room completely equipped for the purpose; one schoolroom; one dining room with a diet kitchen; one recreation room; one nurse's room; ample closet and storage room.

equipped according to modern hospital standards and houses laboratories for both routine and research work. The sixth building is similar in floor plan to the others, but it is devoted to children who are convalescing from a recent active episode who show only laboratory evidence of rheumatic infection. This building serves as a stepping stone from the active to the inactive period of sanatorial care. The basement floor of one building serves as an admission quarters where new patients may be isolated for a period of three weeks.

TYPES OF PATIENTS ADMITTED

Any boy 6 to 8 years of age or any girl 6 to 15 years of age who is suffering from acute rheumatic fever is admitted to the sanatorium. These patients may be referred from the wards of any of the hospitals of the city of New York and Nassau or Suffolk counties, from any clinic of the City, or from the home of the patient. Any form of rheumatic heart disease without regard to extent of anatomical lesion, functional disturbance, or cardiac size is accepted.

Children with active rheumatic disease are, as a rule, sent to the sanatorium directly from the wards of hospitals. No prejudice is held out against the severity of the rheumatic activity or the duration of the active episode in accepting patients for admission. Children with acute Sydenham chorea are accepted.

Patients whose cases are completely inactive and do not demonstrate any laboratory signs of rheumatic infection are not accepted. The sanatorium does not treat poorly nourished children who have a history of rheumatic disease but have no evidence of clinical or subclinical active infection. Similarly, children with a history of rheumatic disease and repeated upper respiratory infections but without active rheumatic infection at the time of admission are not accepted.

It is our conviction that "quiescent" patients, whatever their general well-being may be, will do better if properly supervised at home. Sanatorial care may prevent and postpone rheumatic recurrences in such children, but similar results may be obtained in the more simplified and economical environment of the patient's home or a foster home. It cannot be expected that a community organization program should provide sanatorial beds for the thousands of rheumatic children requiring wholesome "convalescent" care.

DURATION OF STAY AT SANATORIUM

The average stay at the sanatorium is, at present, ten months. Each case is judged on its own merits. The minimum period is seven months while the maximum period may extend to several years. The clinical course is the factor which decides when a child is to be discharged. In general, it may be said that the decision is influenced by the following considerations:

1. *Duration of Active Episode.*—The longer the period of activity, the longer will the patient remain at the sanatorium after all clinical evidence of active disease has subsided. No child is discharged until eight months have elapsed following complete subsidence of rheumatic activity.

2. *Type of Active Episode.*—Children who are admitted with active carditis or signs of cardiac insufficiency will remain a longer period after reaching the ambulatory state.

3. *Rheumatic History.*—A child who presents a history of repeated active episodes will be retained at the sanatorium during the "critical" season of the year—December, January, February, March, and April.

4. *Age of Patient.*—In general, all factors being equal, children 6 to 10 years of age are kept longer than those 10 to 16 years of age.

5. *Home Environment.*—Children who come from a poor home environment will be kept longer than those who have good living conditions at home.

6. *Clinical Improvement.*—Before a child is considered for discharge, he must show:

(a) Definite and consistent nutritional improvement,
(b) Definite improvement in cardiac reserve,
(c) No evidence of infection on repeated complete examinations.

PERSONNEL

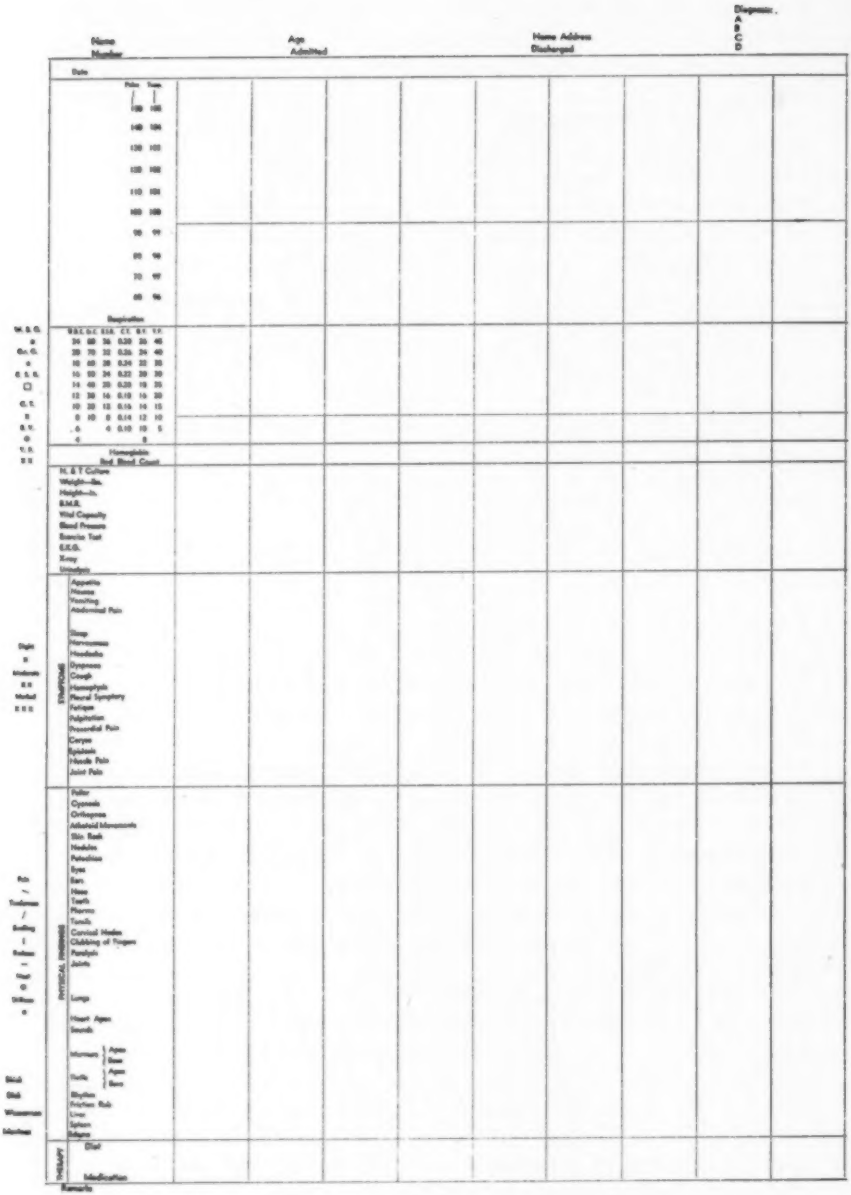
The institution has six graduate nurses and twelve undergraduates who are sisters of the order of Franciscan Missionaries of Mary. The nurses who occupy key positions have been trained in the care of children with rheumatic disease since the inception of the institution in February, 1937.

The medical director controls the medical policies with regard to admissions and discharges and supervises all unusual forms of therapy. He supervises all research and directs the activities of the visiting staff which consists of eight physicians, most of whom have had an excellent training in pediatrics and some in cardiology. Two visiting physicians are on service at all times. There are four visiting dentists, one of whom visits the institution weekly. The sanatorium has one full-time resident physician.

The laboratory personnel consists of a full-time director and four assistants. The technical assistants are sisters who have been trained on the premises by an able chemist and well-trained bacteriologists. In addition, one sister has been trained to make cardiograms and metabolism tests. Another sister has been trained to take x-ray films.

The administrative head of the sanatorium is the Mother Superior who is in control of all phases of sanatorial care and sits in on all conferences dealing with medical policy.

The relationship between the administrative and medical departments is on a uniquely cooperative basis. All administrative, as well


Name
Number
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Home Address
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A
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D
Date
Pulse
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Hemoglobin
Red. Blood Count
W. B. C.
Diff. C.
Eos.
Bas.
Ly.
Mo.
P. M. N.
S. V.
U. S.
H. & T. Cultures
Weight—lbs.
Height—in.
B.M.R.
Vital Capacity
Blood Pressure
Kremin Test
E.K.G.
X-ray
Urinalysis
SYMPTOMS
Appetite
Nausea
Vomiting
Abdominal Pain
Sleep
Nervousness
Headache
Dyspnoea
Cough
Hemoptysis
Pleural Symptoms
Fatigue
Palpitation
Precordial Pain
Coryza
Epistaxis
Muscle Pain
Joint Pain
PHYSICAL FINDINGS
Pallor
Cyanosis
Orthopnea
Adenoid Mouth
Skin Rash
Nodules
Petechiae
Eyes
Ears
Nose
Teeth
Pharynx
Tonsils
Cervical Nodes
Clubbing of Fingers
Paralysis
Joints
Lungs
Heart Apex
Sounds
Murmurs
Pulse
Rhythm
Friction Rub
Liver
Spleen
Edema
THERAPY
Diet
Medication
Remarks

Fig. 1.

as medical, policies are viewed only as regards the well-being of the patients. Compromise is the rule, and the best possible sanatorial care is the aim.

CLINICAL RECORDS

The child is admitted to the institution with a record stating all pertinent facts in the social and medical background of the child. The important facts in the rheumatic history are related chronologically. A preadmission physical examination is recorded. A maximum of laboratory data which helps to rule out contagion and corroborate or deny an active rheumatic infection is required. The results of a nose and throat culture for Klebs-Löffler bacillus and vaginal smear for gonococcus, as well as a Schick and Wassermann tests, are noted on the admission sheet. A positive tuberculin test must be supplemented by a negative chest plate before admission. A preadmission complete blood count and sedimentation rate are recorded. Unusual and important findings on the cardiogram and teleroentgenogram prior to admission are recorded on the admission sheet.

Within the first seventy-two hours of admission complete examinations are carried out and recorded. This consists of a physical examination; blood chemistry; blood count, sedimentation rate, and urine analysis; bacteriologic examination of nose and throat for Klebs-Löffler and *Streptococcus hemolyticus;* physical measurements—height, weight, vital capacity, basal metabolism; electrocardiogram and fluoroscopic examination of heart; clinical measurements—temperature, pulse rate, and respiration rate.

These data are recorded graphically on a clinical chart (Fig. 1). On this chart is recorded a day-to-day account of all clinical data, as well as observations by the nurses and doctors, medication, diet, and therapy. Events considered abnormal are charted in red and normal events in black. One sheet is a record of nine weeks' duration. This span of nine weeks was chosen on the basis of experience as changes in the status of the rheumatic activity can be observed in the majority of patients in a span of nine weeks. Day-to-day comparison is misleading; a week-to-week or fortnight-to-fortnight comparison tells the story.

Laboratory and other data are recorded in detail on special sheets. Cardiograms, taken in six leads, are mounted and analyzed and, together with stethograms, are mounted in the same folder. Progress notes by the medical director, visiting staff, and resident physician are noted frequently and in detail upon progress sheets.

This rather elaborate system of clinical recording has a threefold purpose:

1. To obtain an accurate history of the course of active rheumatic disease.
2. To detect early signs of reactivity.
3. To establish criteria for rheumatic quiescence.

TREATMENT

Upon admission the condition of the patient is considered active until proved inactive. The criteria for activity are divided into three groups:

1. Obvious signs or symptoms of active rheumatic infection—arthritis, chorea, and clinically obvious carditis.

2. Secondary signs of activity—loss of weight, pallor, low-grade fever, slightly elevated pulse rate, rapid sedimentation rate, low vital capacity, slight deviations on cardiogram, occasional so-called "rheumatic" complaints (joint aches, fatigability, poor appetite, occasional epistaxis, restless sleep).

3. Clinical impression of rheumatic carditis. This impression is gained only with a wide experience of mild rheumatic carditis.

Complete bed rest is required until all criteria for activity have subsided. In many instances the final judgment is based upon the clinical impression irrespective of some of the adverse findings of the laboratory, and conversely cases of many children are declared as active when all laboratory evidence is to the contrary.

Therapeutics

Active Cases (Medicinal).—The medicinal armamentarium and its application take into consideration the fact that overtreatment in rheumatic active disease delays recovery. Medicinal therapy is at best only palliative and directed to the alleviation of symptoms. Salicylates, sedations, and cardiac stimulants are used when indicated by annoying symptoms. Digitalization, diuretics, oxygen therapy, and intravenous therapy, are used in heart failure. Until specific therapy is found, the medicinal therapeutics at the sanatorium occupies a place of secondary importance.

Psychologic Approach: Of primary importance, in our opinion, is the careful psychologic approach. The creation of a proper attitude toward the disease in the mind of the child and his rapid and correct adaptation to sanatorial care are of utmost importance in the progress of the disease. Every effort is made to gain at once the confidence of the child. The nurses and doctors keep in the foreground daily encouragement and hope for rapid and complete recovery. The confinement is presented as temporary and, by an atmosphere of peace and contentment, the period of bed rest is tolerated when measured in weeks and not days. The apparently slow movement of the personnel and the avoidance of rush and confusion produce an atmosphere of peace and relaxation. All orders are carried out by following example rather than by insistence. All nurses are called "mother" and make a uniquely successful attempt to live up to that connotation.

Members of the medical staff have been impressed with the importance of a carefree and undisciplinized bedside manner. An attempt is made to learn quickly the individuality of each child and adjust one's professional care accordingly. Mary is apprehensive about her

heart. Her heart receives intelligent neglect on the part of the examining physician. Catherine is worried about the prognosis. Her prognosis is discussed repeatedly in a most hopeful manner. Johnny is anxious to be out and play out-of-doors; his physical abilities are emphasized and exhibited at rounds.

At medical rounds discussions are carefully recorded. Medical terminology is avoided at the bedside. Unfavorable prognosis is not noted at the bedside. During rounds, all patients are examined in a like manner, irrespective of the medical status, and progress notes are dictated within the hearing of the patient, omitting unfavorable comment until after the rounds. Every effort is made to avoid a professional doctor-patient relationship during the course of examination.

Bedside Teaching: All children receive bedside teaching. The teaching is individualized not only on the basis of scholastic standing, but also on the basis of limitations imposed upon the child's abilities by the severity of the active infection or by the low cardiac reserve. Here again, the differences between children are not accentuated. The amount of work assigned to the sicker children is presumably dependent upon the scholastic progress rather than the severity of the illness. Aptitudes are encouraged and fostered. The burden of competitive examinations and grading is completely avoided.

Occupational Therapy: Occupational therapy during the active period is not encouraged. During the summer months when didactic teaching is interrupted, some form of occupational training is substituted in the morning hours but without an exaggerated emphasis. Considerable freedom of choice as to occupational work is provided.

Isolation for Sick Patients: Children who present symptoms of active disease or cardiac disability which are obvious to other patients are treated in private rooms. Here they remain until all distressing signs or symptoms have subsided. Similarly, therapeutic procedures which may disturb the children on the ward are never attempted in the presence of the other children. The patient is removed from the ward to the treatment room. No patient is ever screened from the other patients.

Subacute Phase.—When all clinical signs of activity have subsided, the child is said to enter the subacute phase. The child is removed to the "convalescent building" where a program leading to a rapid resumption of normal childhood activities is instituted. The beds are low and homelike. Meals are taken in a dining room. Teaching is done in a classroom. More and more activities are gradually but definitely and systematically added to the daily routine, punctuated by periods of rest. Medical examinations and observations are conducted less frequently. The child now reports to the doctor for examination analogous to a clinic visit. Laboratory examinations are done in groups and most of the procedures are carried out by a sister who is known as "mother" and not as laboratory technician. Teaching is

done in a classroom, but little stress is made upon rapid academic progress. No competition and embarrassing quizzes are practiced.

Quiescent Phase.—Having been observed in the convalescent building for several weeks, an inventory is then taken of the progress since admission. If the child does not show any evidence of a rheumatic reactivity and continues to show definite improvement nutritionally, he or she is transferred to the inactive building.

The management of quiescent cases is based on the premise that normal childhood activity is harmless to quiescent hearts, irrespective of the amount of valvular damage. To this premise we have found only very occasional exceptions among the older age group where cardiac reserve has been permanently impaired. Thus, in the buildings for inactive cases we classify the children according to age groups rather than to the extent of cardiac damage. Here they live in groups of twenty-five children in an atmosphere approaching that of a boarding school. Their daily activities approach normal except for a two-hour rest period after lunch and the omission of competitive physical exercises. Indoor and outdoor activities are encouraged and carefully guided. Schooling does not differ from the usual schooling at home except that all teaching is done during the morning hours. Medical observations are done routinely at stated intervals and in groups. Laboratory examinations are continued at stated intervals and also in groups.

Transition from Sanatorium to Patient's Home

During the eight to ten months' observation in the building for children with inactive conditions, an attempt is made to bring about an easy transition from sanatorium to home care. The activities are not limited, and regimentation and discipline are completely avoided. While the medical observation continues, its importance in the daily routine assumes a secondary place. On the other hand, it is during this period that matters pertaining to physical and mental hygiene are stressed. Among the older group of children, home environment and the subject of returning home are frequently discussed. In this group, also, vocational training is discussed, and in the course of time the idea of choosing occupations which measure up to the cardiac reserve is fostered. Admittedly, these children are not always happy over the prospect of returning to their home environment. The greatest majority, however, accept the return home as a challenge to continue their state of well-being and, when possible, to help to improve their home environment.

EDUCATIONAL PROGRAM

The medical director supervises all medical education. Members of the visiting staff, as well as occasional invited guests, participate in carrying out the program of medical education. Daily conferences of the medical director with the resident physician are held, at which the fundamental sciences of physiology, pathology, pharmacology, chemis-

try, and bacteriology are discussed in relation to the general subject of heart disease and with particular emphasis on rheumatic heart disease in children. One full morning weekly is devoted to a close analysis of all acute cases at "grand rounds." At this time the fundamentals of cardiac therapeutics are presented. A full afternoon weekly is devoted to a study of cardiac size by fluoroscopy, at which time also the principles of chest roentgenology are taken up. Another full morning weekly is devoted to a study of cardiographic tracings and a discussion of the principles of cardiography. Several afternoons are profitably spent in the study of ambulatory patients. The resident also participates in a discussion of laboratory procedures as related to both routine and research problems.

In addition to this individual instruction in clinical cardiology, the resident physician participates in the monthly clinical conferences. At these meetings members of the visiting staff discuss cases of particular clinical interest. The resident physician presents the history of the case and is expected to defend his management of the case. He is encouraged to present his case in the form of a paper and familiarize himself with the literature bearing upon the point at issue. A résumé of this paper and the discussion which follows are incorporated in the minutes of the conference.

Research problems are suggested to the resident from time to time. These investigations are discussed and analyzed at frequent intervals in conference with the medical director. Problems involving laboratory procedures of a special nature are carried out by the laboratory staff and discussed at frequent intervals with the laboratory director.

All nurses in charge of active rheumatic children are present and are expected to participate in the discussions at "grand rounds." At this time the importance of observation of symptoms and their meaning is fully discussed. In addition, a fortnightly lecture is given to all nurses by the medical director and invited guest speakers. These lectures deal with the clinical and sociologic aspects of heart disease in children. The principles of nursing care and observation are stressed. Reading is suggested and encouraged.

From time to time a speaker is invited to present before members of the visiting staff some of the latest concepts in the field of rheumatic heart disease. The presentation of controversial viewpoints opens the way for profitable discussion and stimulates investigation.

Since our school teachers are provided by the Board of Education, no organized medical education is planned for them at the sanatorium. Occasional informal discussions are held with the medical director, and the special problem of the education of cardiac children is discussed.

No group instruction of parents is given at present. The visiting hours are short and spaced at monthly intervals. Furthermore, most of our patients come from well-organized cardiac clinics where such instruction is given by the medical social workers. Individual instruction,

however, is given in the majority of instances, with a view of presenting the problem of rheumatic heart disease in its proper perspective and carefully planning the future for the child. In many instances written instructions are given as to the home care of the child upon discharge.

This field has not been adequately explored, and a more complete program is in preparation. It is felt that the education of the parents in some of the clinical and psychologic problems, and particularly in the fundamental principles of home care, offers a most fertile field in which to reap the greatest benefits to these children. A program of parent education will be initiated in the fall of 1942.

An extensive postgraduate course in heart disease in children has been organized. This course will not be given for the duration of the war.

Many avenues of investigation are pursued at the sanatorium. Because of the very detailed record system, many valuable observations are accumulated and classified in a statistical manner. This accumulation of facts pertaining to the natural history of rheumatic disease is bound to bring to light important observations.

Active research is conducted along three main lines: *Clinical investigation, cardiac physiology,* and *bacteriology and immunology.*

The St. Francis Sanatorium for Cardiac Children has been established on the principle that rheumatic disease in children in the acute stage cannot be adequately treated under the conditions present in the usual children's hospital and that the sanatorium is a better environment for the management of this baffling disease. The disease presents bizarre and ill-understood phenomena. The sanatorium, therefore, must definitely contribute to the knowledge of this disease. Five years' experience at the sanatorium gives definite encouragement to continue with the plan as formulated. Our results thus far give unmistakable promise of favorably influencing the course of the disease in our patients. Our mass experience leads to a clearer understanding of the disease.

BRONCHOSCOPY IN THE NEWBORN INFANT

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BRONCHOSCOPY is seldom indicated in the treatment of diseases of the newborn infant. On rare occasions it is a life-saving procedure in certain cases of atelectasis due to obstruction of the bronchi by body secretions, and at other times it may establish a diagnosis when the pulmonary and radiologic signs are confusing.

The procedure should not be undertaken lightly, nor too hastily; when gentleness and the proper size bronchscope are used, no ill effects have been noted. One of our patients was a premature infant, approximately 4 pounds in weight, who was not only bronchscoped twice but had an iodized oil injection in the tracheobronchial tree for radiologic diagnosis.

We are impressed with the experience of Dr. Maurice G. Buckles, Louisville, Ky. In a personal communication he summarized his experience as follows: "I have been impressed with the efficacy of the procedure and have had no deaths immediately following bronchoscopy, even in the presence of severe cyanosis. Atelectasis is an important cause of breathing difficulty in the newborn infant, and the bronchoscopy is definitely indicated, for prognosis depends a great deal on early recognition and aspiration. I have treated seventeen such cases, eleven of which were immediately relieved, two of these being premature." The number of infants treated by Dr. Buckles suggests that he may have found bronchoscopy useful in the usual types of congenital atelectasis for which there is, at present, no satisfactory treatment.

The indications for bronchoscopy in the newborn infant are not clear-cut. The decision must be made in each case only after careful consideration by the pediatrician and bronchoscopist, after the usual procedures have failed to either clear the lung or establish a diagnosis. We do feel, however, that it should be used more frequently, since it has been established that it can be done with safety and benefit to the patient.

The following case reports illustrate the safety and value of the procedure in these obscure but not infrequent cases.

CASE 1 (157813).—Massive congenital atelectasis, left lung, from bronchial obstruction by body secretions.

A 5.5-pound twin was brought to the hospital six hours after birth because of persistent cyanosis and dyspnea. The baby was placed in an incubator with an attached oxygen unit and the cyanosis cleared but returned whenever the baby was

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Read before the American Broncho-Esophagological Association, Atlantic City, N. J., June 9, 1942, and before the meeting of Region III, American Academy of Pediatrics, Richmond, Virginia, Nov. 11, 1942.

Fig. 1.

Fig. 2.

Fig. 1.—Massive congenital atelectasis, left lung, from body secretions.
Fig. 2.—Same patient as in Fig. 1 two days after bronchoscopy. Lung is now well aerated.

removed from the incubator. A roentgenogram of the chest revealed the left lung to be entirely collapsed with the heart and mediastinum drawn toward the left. The ribs were at a right angle to the spine, and the interspaces were narrowed as shown in Fig. 1.

There was no improvement after two days, so the 3.5 mm. bronchoscope was introduced. No marked bronchial obstruction was noted, but suction was applied to the left bronchus for thirty seconds. The procedure lasted approximately three minutes.

Symptomatic improvement was prompt, and a roentgenogram two days later showed normal aeration, as seen in Fig. 2. The infant made a complete recovery, although moribund at the time of bronchoscopy.

CASE 2 (164343).—Massive congenital atelectasis, left lung, due to congenital absence of the left main bronchus.

A 4.1-pound premature baby was born on Jan. 5, 1941. Because of cyanosis and dyspnea, it was placed in an incubator with an attached oxygen unit, which relieved the cyanosis. Cyanosis promptly appeared each time it was removed from the incubator. No breath sounds could be heard over the left lung. A roentgenogram showed an opague left lung with the heart and mediastinum drawn toward the left side. The left ribs were shelving downward, and there were anomalies of the three upper ribs on each side. Bone anomalies were noted in the lower cervical and upper dorsal vertebrae, the centers of ossification being scattered around without any definite arrangement. It was also noted in the physical examination that there was a supernumerary left ear.

A second roentgenogram two days later showed no change, and a third roentgenogram five days later again showed no change; and since cyanosis and dyspnea appeared each time the baby was taken out of the incubator, it was decided to do a bronchoscopy regardless of the anticipated danger, since the baby was premature, for it was now felt that there was very little likelihood of the lung becoming aerated without some aid.

On Jan. 14, 1941, nine days after birth, the 3.5 mm. bronchoscope was readily introduced. The larynx was noted to be quite small, much smaller than that of a full-term infant. The trachea was likewise quite small, and the bronchoscope fitted rather tightly. A definite bulge was noted on the left side of the trachea. The trachea was followed downward, and only the one lumen was seen, apparently leading into the right lung. No evidence of a left bronchus was visualized; however, due to the small size of the structures, it may have been overlooked. A small amount of mucus was aspirated; no further pathologic changes were noted. The examination was terminated and the baby placed in the oxygen incubator, apparently no worse for the procedure.

Since the condition of the baby was unchanged and no ill effects had been suffered from the first bronchoscopy, it was repeated on Jan. 23, 1941, nine days later. This examination was carried out in a more leisurely manner, since our confidence had now been bolstered. Again no evidence of a left main stem bronchus could be found, and it was felt that we were probably dealing with a congenital anomaly. The procedure was well tolerated.

On Jan. 31, 1941, eight days later and twenty-six days after birth, the trachea was injected with 2 c.c. of iodized oil through the laryngoscope, and roentgenograms were made. The oil was then removed by suction. The baby stood this procedure well. The roentgenograms showed all of the oil in the trachea, mesial portion of the right lung, esophagus, and stomach. The left lung was still completely atelectatic. At a point where the left main stem bronchus would be expected to start, there was a slight notch. Conclusion: Complete obstruction in the first portion of the left main stem bronchus. Films made the following day showed none of the oil. The lung findings were unchanged.

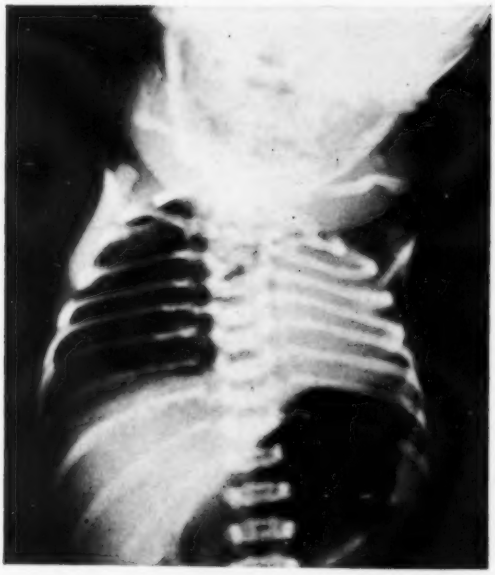

Fig. 3.—Massive congenital atelectasis, left lung.

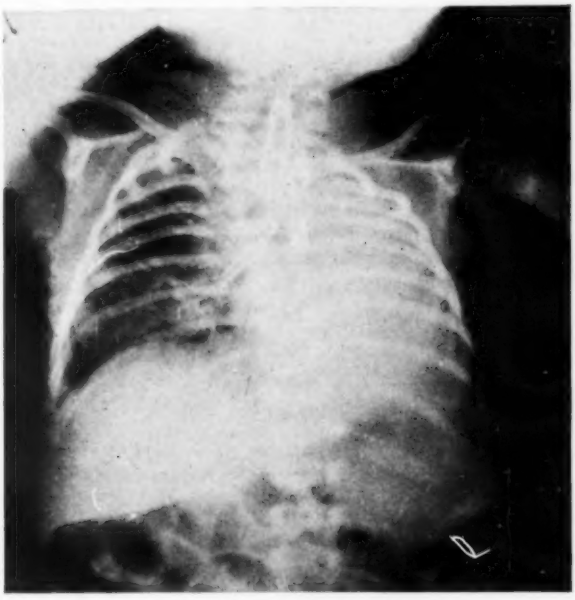

Fig. 4.—Same patient as in Fig. 3, with tracheobronchial tree injected with iodized oil, showing absence of left main bronchus.

The baby was discharged nine days later, being then able to stay out of the oxygen incubator, and had gained one-half pound. The child is now 16 months old and the lung still unaerated.

CASE 3 (167887).—Massive congenital atelectasis, left lung, due to congenital absence of left main bronchus.

Although not germane to the subject, a case of an 11-year-old boy with the same anomaly is reported with the preceding cases of newborn infants to show what may be expected in later years; also, because of its rarity and interest.

April 28, 1941, this boy was admitted for study because of unexplained atelectasis of the left lung and scoliosis.

This boy had been recently treated for measles, from which he had made an uneventful recovery. However, during this attack, the marked scoliosis and atelectasis were noted. This patient had had the usual diseases of childhood but had otherwise been in good health. He had been observed by other physicians, and a tonsillectomy and adenoidectomy and circumcision had been performed at the age of 8 years. No mention of the condition in the left lung had ever been made, although the pigeon breast had frequently been referred to and there was a history of respiratory difficulty after birth.

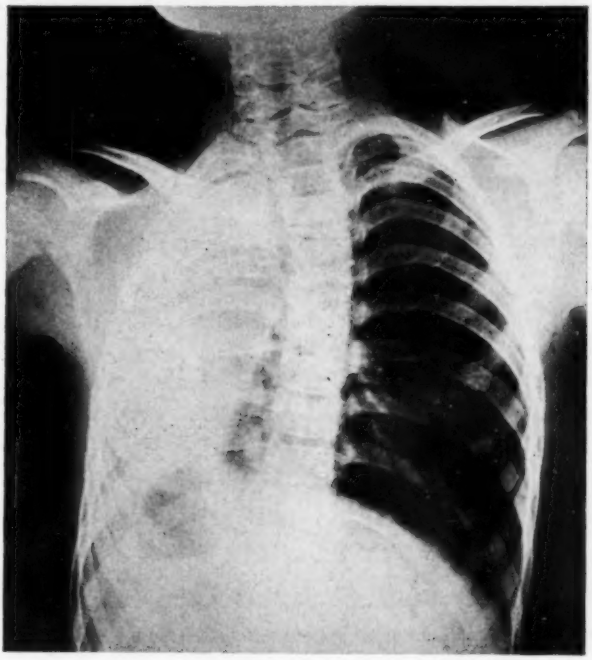

Fig. 5.—Massive congenital atelectasis, left lung, from absence of left main bronchus in an 11-year-old child.

Physical examination was entirely negative except for the chest condition. Roentgenograms on April 28, 1941, showed complete atelectasis of the left lung. A part of the right lung was seen on the left, and the heart and mediastinum were markedly drawn to the left side. The right lung was emphysematous. The ribs on

the left were drawn closer together, producing a right lateral scoliosis. The left diaphragm was elevated. No radiopaque foreign body was present. No cause for this atelectasis was apparent.

A diagnostic bronchoscopy was done on May 2, 1941. The trachea was so small that a 5 mm. bronchoscope was passed with some difficulty; in other words, the trachea was approximately the size of the right main stem bronchus. The bronchoscope passed directly into the right main bronchus, and its main divisions were identified. There was no evidence of the lumen of the left bronchus. At the approximate level of this bronchus there was a ridge across the left wall which possibly represented the carina. It is believed that we were dealing with a congenital absence of the left main stem bronchus. Iodized oil was injected, but the injection was unsatisfactory, and no additional information could be gathered from the roentgenogram.

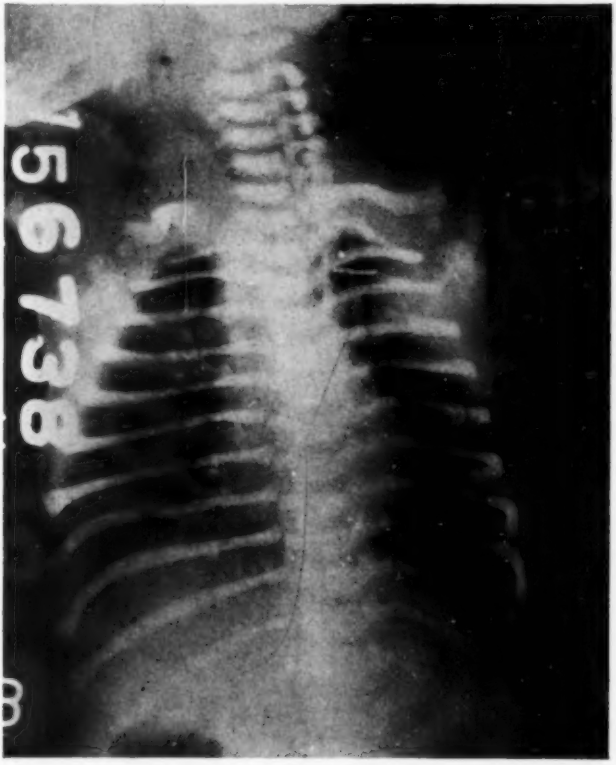

Fig. 6.—Partial congenital atelectasis bilateral with pneumothorax.

The family would not permit further study, so the patient was discharged the following day. He has remained well since and has been fitted with proper orthopedic appliances.

CASE 4 (175024).—Partial congenital atelectasis and pneumothorax. The baby in this case was born on Dec. 17, 1941, and, since cyanosis was marked, he was placed in oxygen but with only slight benefit. Roentgenograms on Dec. 18, 1941,

showed no apparent obstruction in the pharynx or trachea. There was marked emphysema of both lower lobes and a small pneumothorax pocket in the lateral portion of the left costophrenic angle, probably due to a rupture of an emphysematous bleb. In contrast, the upper lobes were increased in density with a string-like accentuation of the bronchial markings, suggesting a partial atelectasis. The heart appeared normal.

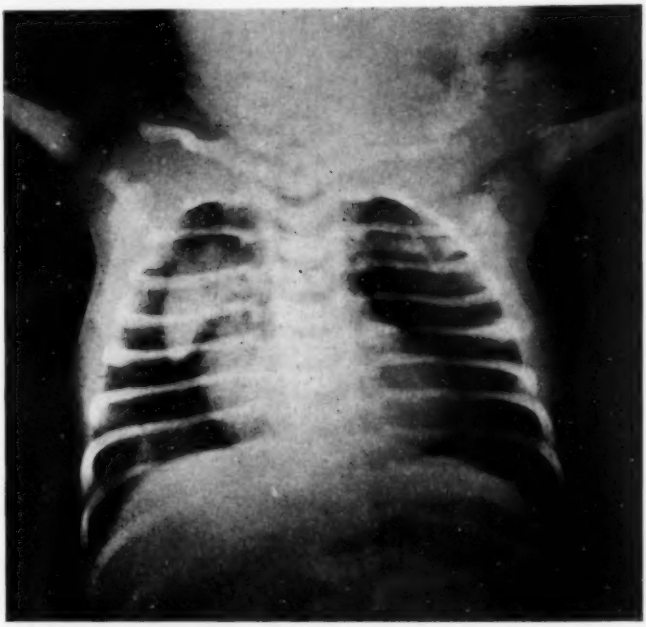

Fig. 7.—Partial congenital atelectasis, right upper lobe and pneumothorax.

Since the baby's condition was critical, a bronchoscopy was requested, in hopes that aeration could be obtained. So the same day, the 3.5 mm. bronchoscope was introduced and both main stem bronchi aspirated. A small amount of secretion was present but no bronchial obstruction was noted. Two days later slight improvement seemed to be present, so the procedure was repeated and mucus was aspirated from both main bronchi. Breathing seemed to be easier after operation. Death followed several hours later but was in no way associated with bronchoscopy. Unfortunately, no autopsy was obtained.

CASE 5 (177720).—Partial congenital atelectasis with pneumothorax. This baby was brought into the hospital five hours after birth, March 22, 1942, because of persistent cyanosis. A roentgenogram revealed atelectasis in the right upper lobe and partial pneumothorax. The baby did not improve under oxygen, and his course was progressively downhill. A bronchoscopy was done the day after admission, but no obstruction to the airway was noted, and no secretions were present. The whole examination lasted about one minute, and the infant stood the operation well. The baby was returned to the oxygen incubator but died several hours later. Unfortunately, no autopsy was obtained.

Bronchoscopy was of no value in these last two infants because the congenital condition was not one of atelectasis due to body secretions. However, the procedure was well tolerated, and since we were faced with a hopeless condition, bronchoscopy was advised and done with the hope that better aeration might be obtained.

CONCLUSIONS

Bronchoscopy can be carried out in newborn infants with safety, and at times is a life-saving procedure. At other times it aids in establishing a diagnosis. If employed more widely for all types of congenital atelectasis, the indications and contraindications will be sooner understood and lives will doubtless be saved.

INFANTILE SCURVY

A Case Report With Follow-Up Roentgenogram of Pre-Existent Healed Scurvy

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ROENTGENOGRAMS taken years after clinical cure of infantile scurvy present findings which are not as well known as the early changes.[1-5] In war, scurvy becomes more prevalent not only among adults, but also among infants.[6]

It would be of interest at this time to present this case report and describe again briefly the roentgenologic signs of pre-existent scurvy.

CASE REPORT

S. R., a colored female infant 9 months of age, was admitted to the pediatric service of Dr. Tepper and Dr. Martin on Oct. 30, 1937, because of a prolapsed rectum, which appeared two days before admission, and painful swollen thighs of several days' duration. She weighed 5½ pounds at birth, the delivery being spontaneous. The feeding history was rather vague. The infant was bottle fed since birth, receiving boiled grade A milk, water, and dextrimaltose in varying amounts. The only other food given was cereal. Orange juice and cod-liver oil were offered, but the infant refused to take them.

The weight upon admission was 10 pounds, 3½ ounces, and the axillary temperature was 100.6° F. The child seemed acutely ill and fretful. The respirations were rapid, and the thighs and legs were flexed and held in external rotation. The two lower incisor teeth were present and about these the gums were swollen, congested, and purplish in color. The heart rate was very rapid. The lungs were clear. There was no craniotabes, and the anterior fontanel was almost completely closed. The costochondral junctions were enlarged and prominent. The rectum protruded from the anus for several inches. The extremities were tender, and there was pain on motion. Both thighs were markedly swollen.

The urine was negative. The blood showed a marked anemia with a hemoglobin of 35 per cent and red blood cells, 2,500,000. The white blood cells were 13,900; polymorphonuclears, 56 per cent; and lymphocytes, 44 per cent. Polychromatophilia and anisocytosis were present. The serum calcium was 8.4 mg. per 100 c.c., and inorganic phosphorus was 4.2 mg. The capillary resistance test with the blood pressure cuff at systolic pressure for three minutes showed only three to four petechiae.

The infant was placed on four ounces of orange juice, evaporated milk, and water and twenty drops of oleum percomorphum daily. Local treatment was instituted for the prolapsed rectum. In addition, iron, vegetables, and cereals were given. The blood several days later showed a hemoglobin of 50 per cent and red blood cells, 3,340,000.

For the first ten days the axillary temperature fluctuated between 100 and 101° F. The heart rate and respiratory rate remained elevated for the first few days. The infant improved rapidly, and the tenderness of the extremities sub-

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sided completely in sixteen days. The rectal prolapse remained reduced after two weeks. The infant gained progressively in weight throughout the hospital stay and was sent to the Wave Crest Convalescent Home five weeks after admission. A follow-up study at that institution revealed that she started to walk in the latter part of the summer of 1938. Orthopedic examination at that time revealed slight bowing of the femur, but no local treatment was necessary. The rectal prolapse recurred several times, and she was operated upon in February, 1939. In 1942 the child appeared normal and walked well but had a slight internal strabismus of the right eye.

Fig. 1.—Roentgenogram of lower extremities one week after treatment.

Fig. 2.—Roentgenogram of lower extremities four and one-half years after onset. Oval circumscribed areas of rarefaction in capital epiphyses and distal epiphyses of femur and proximal epiphyses of tibia.

COMMENT

The characteristic findings in the roentgenogram taken years after clinical cure are oval, definitely circumscribed areas of rarefaction found in the interior of the epiphyseal centers of ossification. These lesions are always bilateral. These centers of ossification are present in the acute stage of the illness.

According to Steinberg and Sussman,[5] the blood supply to these centers of ossification is not very rich and is independent of the blood supply to the diaphysis. Upon union of epiphysis with diaphysis there is a concomitant enrichment in the blood supply to the epiphyseal center of ossification and the rarefied area disapears. These investigators feel that these lesions are pathognomonic of healed pre-existent scurvy and may be confused with bone cysts. Schwartz[2] stated that this roentgenologic sign was seen in no other condition. On the other hand, McLean and McIntosh[3] found similar roentgenograms in two cases; one in a patient with acute lymphatic leucemia, another in a patient with anemia of the von Jaksch type. Similar roentgenograms have been found in several cases of healed rickets. These lesions in the epiphyseal centers of ossification may not be pathognomonic of healed pre-existent scurvy, but they are very characteristic of it.

In the postwar period radiographic studies of children living in countries where food restrictions prevailed might be confusing if the signs to which I have called attention are not recognized and considered.

SUMMARY

A case report is presented with the classical symptoms and typical roentgenograms of acute infantile scurvy. A follow-up roentgenogram four and one-half years after clinical cure is presented with the characteristic findings.

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SEVERE SUBLINGUAL AND PARATRACHEAL HEMORRHAGE IN HEMOPHILIA WITH RECOVERY FOLLOWING TRACHEOTOMY

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THE hemophiliac patient is in constant danger of death from hemorrhage. There is, however, one type of bleeding in hemophilia where the danger does not lie primarily in the blood loss. This is hemorrhage which occurs into the sublingual and paratracheal tissues. The resulting tracheal compression with edema of the larynx may lead to increasing respiratory distress and finally asphyxia before the blood loss is in itself significant. The bleeding in these instances may arise from the tongue, from a tooth socket, or from the peritonsillar area. Extension of the hematoma downward along and above the mylohyoid muscle to the tissues about the larynx and trachea produces the dyspnea. Tracheotomy may be necessary in spite of the risk of bleeding.

This complication of hemophilia is rare. The outcome in patients with severe cases has been almost uniformly fatal. For this reason we are presenting a report of our case. No unusual form of treatment was employed. Two factors which probably contributed to the favorable outcome are:

1. Tracheotomy was done early, within five hours of the onset of obstructive symptoms.

2. As a known hemophiliac, the child was treated adequately with blood transfusions.

REVIEW OF THE LITERATURE

1. *Cases in Which Patients Did Not Have Tracheotomy.*—Umbreit[1] described the case of a 30-year-old known hemophiliac whom he successfully treated for massive hemorrhage into the tongue and sublingual tissues. Treatment included incision into the area of hemorrhage. There was considerable bleeding from the incision, but the patient recovered without transfusion.

Feliciangeli[2] reports the case of a known bleeder who suffered a sudden hemorrhage into the sublingual and suprahyoid area. Tracheotomy was considered because of dyspnea and cyanosis, but relief was obtained by two paramedian incisions into the area of swelling. The patient had a prolonged convalescence. The bleeding from the wounds was finally checked by suturing and by the intravenous administration of horse serum.

From the Ear-Nose-Throat Department of the Milwaukee Children's Hospital.

Dujarier[3] describes the case of a 22-year-old hemophiliac treated for submucosal hemorrhage of the right side of the larynx with resulting aphonia and dysphagia but no dyspnea. Recovery followed conservative treatment. This patient gave a history of a previous hemorrhage into the tongue and sublingual area which had subsided without operative intervention.

Troutt[4] reports the case of a 23-year-old hemophiliac whom he treated for a massive hemorrhage into the tongue and floor of the mouth. The patient had some respiratory distress. He recovered after three local incisions and a blood transfusion.

2. *Cases in Which Patients Had Tracheotomy.*—Lesné, Powilewiez, and Récamier[5] report the case of a 15-year-old boy with a history of manifestations of hemophilia dating back to the age of 19 months. The boy was hospitalized at night because of the sudden onset of pain in the throat with swelling of the submaxillary areas. By morning the child's condition was critical. He had marked dyspnea. During the examination the boy collapsed. Tracheotomy was done, but he could not be revived. Autopsy revealed marked edema of the larynx. There was an infiltration of blood about the larynx extending to and filling both submaxillary regions and the floor of the mouth.

Voit and Paus[6] describe the case of a 43-year-old hemophiliac who was hospitalized because of the sudden onset of swelling of the floor of the mouth occurring the night before admission. His tongue was greatly enlarged and blue black in color. A large mass was present under the tongue. This yielded blood on aspiration. Because of increasing dyspnea with stridor and marked air hunger, a high tracheotomy was done. The patient was moribund at the time of operation. He ceased breathing as the tube was inserted and could not be revived. Autopsy revealed extensive hemorrhage into the sublingual and paratracheal tissues.

Endicott, Mitchell, and Qvist[7] describe the case of a 35-year-old man admitted five hours after the uneventful removal of a tender lower right second molar. The bleeding from the socket did not respond to ordinary measures. A history of hemophilia was obtained. Eighteen hours after extraction the bleeding was checked by suturing, but a submucosal hematoma medial to the molar area was noted. Twenty-four hours after extraction this hematoma had spread to fill the floor of the mouth. The patient became progressively worse. He developed severe dyspnea with stridor. Fifty-four hours after extraction a tracheotomy was done. The patient bled continuously from the tracheotomy wound. In spite of blood transfusions he failed rapidly and died twelve hours after tracheotomy. Autopsy revealed massive hemorrhage into the sublingual and paratracheal tissues with no source except the tooth socket.

CASE REPORT

L. K., a 4½-year-old boy of Polish and German parentage, a known hemophiliac, was admitted to the Milwaukee Children's Hospital at 10:30 P.M. on March 20, 1942. This was his fifth admission.

The first admission occurred in 1938 at the age of 11 months when he was treated for a large hematoma in the left axilla. Blood coagulation time was normal. The child improved following a blood transfusion.

The second admission occurring two years later at the age of 3 years was for hemorrhage into the tissues about the left ankle following a puncture wound. The coagulation time of his blood was found to range from ten and one-half to nineteen and one-half minutes. Lee coagulation time was 115 and seventy-three minutes on two determinations. Platelet count, bleeding time, and clot retraction time were normal. Prothrombin was 100 per cent.* The clotting time of the recalcified plasma varied from fifteen to nine minutes.* The diagnosis of hemophilia was made. The boy improved following transfusions.

The third admission at the age of 4 years was for the massive hemorrhage into the tissues of both legs. Recovery occurred without transfusions. A definite familial history was obtained. The patient is an only child. One of his mother's brothers died at the age of 9 months from uncontrolled bleeding. Another of her brothers has a history of bleeding. It was stated that the son of the mother's sister bruises easily.

The fourth admission occurred five weeks later. The child was admitted with severe abdominal pain which was finally diagnosed as due to retroperitoneal bleeding, not appendicitis. Recovery followed treatment with blood transfusions, intravenous fluids, and sulfadiazine.

At the time of this fifth admission the chief complaint was pain in the throat. The child had been seen forty-eight hours before admission and the diagnosis of an upper respiratory infection made. The child subsequently complained of sore throat which became so severe that he refused to swallow.

Examination on admission revealed an acutely ill child. His temperature was 101.2 (rectal). There was some respiratory distress. The child was drooling, and the mouth and throat were full of mucus. The entire pharynx was inflamed. Surrounding the upper pole of the left tonsil was a bulging rounded mass, partially discolored and dark blue. The neck was held stiff. Anteriorly it was diffusely swollen and brawny although not discolored. Laterally it was swollen and tender. The cervical nodes were also tender. The remainder of the examination was negative except for some ecchymotic areas about the right shoulder. The admission diagnoses were: hemophilia, acute tonsillitis with cervical adenitis, and left peritonsillar abscess with hemorrhage. The boy was given codeine and was started on sulfathiazole. Compresses were applied to the neck. Preparations were made to give transfusions to the child in the morning. He was watched carefully during the night for evidences of bleeding.

At 5:30 A.M. that morning, March 21, the nurse noted that the boy's mouth seemed to be full of blood. On examination this was found to be a massive sublingual hematoma which had pushed the tongue to the roof of the mouth. The oropharynx could no longer be seen. By 8 A.M. the child had developed marked respiratory distress. He was restless and apprehensive. Breathing was rapid and was aided by the accessory muscles of respiration. (Substernal retractions were marked.) He presented the characteristic picture of exhaustion from upper respiratory obstruction with the typical ashen gray color. The sublingual swelling was increasing as was the swelling in the neck. He was seen at once by members of the medical, surgical, and ear-nose-throat staffs who agreed that an immediate tracheotomy was necessary in spite of the danger of hemorrhage.

A low tracheotomy was done under local anesthesia. The deep structures of the neck surrounding the trachea were found to be discolored with blood. A No. 3 tracheotomy tube was introduced. This brought immediate improvement in breathing and in color. A small Penrose drain and one suture were inserted at the lower

*Tests done by Dr. Armand J. Quick.[5]

TABLE I

CHART OF PROGRESS

DAY	OPERATION	SULFATHIAZOLE (GM.)	BLOOD (C.C.)	KOAGAMIN	RECTAL TEMP. (°F.)	HIGH PULSE	W.B.C.	R.B.C. (MILLION)	HB (GM.)	COAG. TIME (MIN.)	LEE COAG. (MIN.)
March 20		1			102.6	140					
March 21	Tracheotomy		950		101.6	140	28,700	3.0	7.5		
March 22				2 cc I.V.							
			500	8 cc I.M.	101.8	156		3.48	9.0	4½	
March 23		0.5 t.i.d	500	10 cc I.M.	102	140	26,600	2.95	8.0	3½	
March 24		0.5 t.i.d	500		103.6	128	23,800	3.95	10.5	3	
March 25	Tube occluded	0.5 t.i.d			101.2	128	18,200	4.0	12.5	4	7
March 26	Tube out	0.5 t.i.d			100.8	120	20,200	4.55	13.0	10	
March 27		0.5 t.i.d			99.8	100	16,800	3.70	12.0	4½	
March 28		0.5 t.i.d	400		100.8	128	15,000	3.45	9.5	5½	
March 29		0.5 t.i.d			99	96					
March 30		0.5 t.i.d			99	100	7,800	4.25	12.5	3½	
March 31		0.5 t.i.d			99.8	100	8,400	4.35	12.5	4	
April 1		0.5 t.i.d			98.6	84					
April 2					99	96		5.20	13.0		92
Totals		22.5	2,850								

end of the wound. The child was given 450 c.c. of citrated blood through a cannula in the right ankle vein.

The usual postoperative care for tracheotomy patients was instituted, the humidity of the room being controlled by "cool steam" from a Walton humidifier. The child's condition remained critical all that day although there was no further dyspnea. Moderate oozing occurred from about the tracheotomy tube. Five hundred cubic centimeters more of citrated blood were given during the day, and administration of intravenous fluid was continuous.

The child's subsequent course is shown in Table I. The hematoma resolved rapidly. The day following tracheotomy the child was able to swallow. Food and medication could thereafter be given orally. Examination of the throat revealed purple-black discoloration of the mucous membranes of the floor of the mouth, the left peritonsillar area, and the submucosal tissues of the left oropharynx. Bleeding from the tracheotomy wound presented quite a problem. Repeated transfusions were necessary to control this. A total of 2,850 c.c. of citrated blood was given. Koagamin was given intravenously and intramuscularly without appreciable effect.

By March 25, four days after tracheotomy, the child's blood clotting time was normal. This was attributed to the effect of the repeated transfusions and to the spontaneous improvement which often follows severe hemorrhage. The tracheotomy tube was occluded that day. It was removed the next day without difficulty.

The child continued to make a rapid recovery. The blood coagulation time increased (see Table I) after transfusions were stopped, and the tracheotomy wound continued to ooze occasionally. Bleeding was checked by local applications of silver nitrate or thromboplastin together with pressure bandages. The lower end of the tracheotomy wound where the suture had been inserted was the last area to heal. The boy was discharged on April 16 with the wound well healed.

The child has had three subsequent admissions: in June and July, 1942, for hemarthroses of his left knee, and in September, 1942, for hemorrhage into the muscles of his right leg. He has also had mumps. He has had no further difficulty with his throat. Examination on these subsequent admissions has shown a small, pale, well-healed and inconspicuous tracheotomy scar.

SUMMARY

We have reported the case of a known hemophiliac child who, during the course of an upper respiratory infection, developed a massive sublingual and paratracheal hemorrhage with resultant severe upper respiratory distress. Tracheotomy became necessary and was successfully performed with immediate relief of the respiratory obstruction. Favorable progress followed the use of repeated blood transfusions.

We wish to express our appreciation to Drs. G. W. Fox, F. Mellencamp, I. Schulz, and A. J. Quick for their suggestions as to the management of the child in the case reported.

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STREPHOSYMBOLIA

A Pediatric and a Pedagogic Problem

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I ADMIT that the title of this treatise is rather peculiar for a medical theme. It might seem also that I am a trifle facetious in selecting the word strephosymbolia. Its meaning, as many of you know, is mixed symbols. It was first used in this capacity by Dr. S. T. Orton, formerly of Columbia University, in classifying certain children having difficulty in learning to read; children who mixed up the letters or symbols in words or who could not distinguish well between different letters composing a word, as the letters "a" and "s," "b" and "d," "f" and "t," "m," "n," and "u," and "p" and "q"; and also those who reversed their numerals, reading 21 for 12.

I first became interested in the subject by having two such children, both boys, in my own family. They were passed in school on condition from grade to grade. Their teachers, who should have known how to advise a distracted parent in such a case, could offer no suggestion. The children both, fortunately for their parents, had I.Q.'s well over 100, so it was decided that they were not morons or incipient idiots.

The vision, the hearing, the endocrine system, and all the other systems were thoroughly checked and found to be normal. This, while gratifying to the mother and myself, did not help us in teaching these boys to read.

Finally one of the tutors which we had had told us, after she had taken a summer course at an eastern university, that she had attended a lecture on the subject, "Mirror Readers," and she immediately thought of our boys. This started us surely but slowly on the right path at last, six years late with the older boy and two years late with the younger. Our family history of sidedness was then discovered to be decidedly mixed. So these unfortunate children of ours had an ample "strepho-laterality" tendency in their genes.

The fact that a child may fail to learn to read and yet be of adequate intelligence is receiving increasing attention from educators, psychiatrists, and pediatrists. Until recent years, teachers assumed that a child who attended school regularly could learn to read unless he had poor vision or hearing or was mentally defective.

Read at the meeting of Region III, American Academy of Pediatrics, Cleveland, May 14, 1942.

With the innovation of intelligence and achievement tests, psychologists have been better able to evaluate between measures of capacity and achievement. Even between such closely related abilities as reading and intelligence there may be a range of disparity in which is found such variation as the mentally alert child who cannot learn to read by the accepted method of teaching yet can comprehend material read to him or the defective child who may read well yet is unable to understand or deal intelligently with the material which he reads. The atypical child who cannot learn to read as well as is to be expected from his other intellectual accomplishments presents a serious educational and emotional problem. In order to differentiate such a child from the general defective child in whom the entire intellectual pattern is more or less uniformly retarded, the mentally alert child must be regarded as having a special defect.

Probably the chief factor in bringing reading disability to the fore has been the innovation, some thirty years ago, of the so-called sight or flash manner of teaching reading. Prior to this time we were all taught by the auditory or "a-b-c" method. There is a very good reason for the newer sight method as it is a far more rapid procedure; the gist of the meaning of a paragraph which is read is obtained at a brief glance, because each word does not have to be dissected as is the case in the older auditory process.

In children who have strephosymbolia, the cerebral visual apparatus in receiving, recording, and interpreting is not adapted to the present accepted teaching method of reading. The accomplishment of learning to read and write and then to speak the written or printed word is truly a most complicated process.

We have three highly developed recording mechanisms through which reading may be taught: (1) feeling, or kinesthesia, which method is highly developed in the blind; (2) the auditory; and (3) the visual mechanism.

While cases of reading disability have been found much more frequently since the teaching of the sight method of reading, it has long been recognized that certain children have more or less selective difficulty in learning to read. In 1885, Berkhan reported a few cases. The first on record, he assumed the difficulty was related to a general developmental defect, he applied the term half imbecile to such cases. However, as time went on, more case reports were recorded of children who were obviously intelligent in other respects but who could not learn to read or learned with the greatest difficulty.

Kerr, an English school physician, and Morgan, an English ophthalmologist, published independently in 1896 case reports of children with reading disability who were of normal intelligence.

Morgan considered it to be a specific developmental defect and designated it as congenital word blindness, which term has been widely and carelessly employed ever since. Another English ophthalmologist,

Hinshelwood, studied a series of such cases very thoroughly and compared them critically with cases of acquired word blindness resulting from focal brain injury. He concluded that there might be a congenital defect of development in the brain area for registration of visual memories of words. He published this work in 1917. This has been largely accepted in medical circles as one of the logical causes. This remained unchallenged until Orton, in 1928,[2] published the results of investigative work in this field started by him at the Iowa State University, and he offered the name strephosymbolia as being more applicable to the majority of these cases of difficult reading. His deductions from his research work and his resultant line of argument are most convincing.

Marie has stated that the results in brain lesions in adults after acquisition of speech cannot be applied directly to children in the plastic period of acquisition. He claims that destructive lesions in the so-called speech zone in children do not prevent the acquisition of speech and considers that in the event of such a destructive lesion before training is acquired, there results an education of other areas for this function. Then also the fact that there is complete recovery from the reading disability of severe degree when the child is taught by the right method makes a strong argument against Hinshelwood's theory that congenital word blindness applies to these cases.

Orton contends that the basis of the difficulty really resides in the mixed cerebral dominance. These children can all make proper use of visual memories of objects, calling the names of the objects and pictures very promptly. Their auditory memory is also quite normal and concepts are readily built up from material presented verbally, but such concepts are not aroused by the same material being presented in the written or printed form. These facts focused Orton's attention to the study of their visual brain levels. To quote him: (1) The first level, that of the optic nerve and endings, serves to give awareness that a visual sensation comes from without and is not a recalled memory of things seen. (2) The second level deals with objective memories and serves as a storehouse of visual impressions of objects which have been seen. Up to this point, the two hemispheres of the brain act in unison to produce a single conscious impression. This function is not entirely lost even as a result of destruction of either hemisphere. (3) At the third or so-called associative level, however, destruction in one hemisphere may result in complete loss of the associative function, resulting in the inability to read (called acquired word blindness), while destruction of exactly the same area in the opposite hemisphere will not give rise to any symptoms. The first hemisphere then must be dominant and may be either right or left, according to the side which initiates the motor responses of the person.

Orton further explains that it is quite evident that the visual records of one hemisphere only are used and the other is eliminated or made

inactive. He has called the visual record in the cells of the nondominant half an engram; this would be opposite in sign to that of the dominant half and would form a mirrored pattern. So if the habit of complete elimination of these engrams in the nondominant half is not completely established through a complete right or a left dominance, it would very logically serve to explain the failure to differentiate between letters "b" and "d," "p" and "q," etc., and also to account for the ease of mirror reading and writing. Also to explain the confusions of direction, i.e., reading from right to left, making the word "saw" read "was," and creating word pictures from right to left as in the word "tarnish" —read "tarshin." From a ten-year observation, Orton claims that from 1 to 2 per cent of the school population have a very definite degree of strephosymbolia and up to 4 per cent have mild gradations which eventually adjust themselves, allowing the children to pass along.

Monroe, who has also made extensive studies along this line, claims that 12 per cent of our school population have reading defects. He has made an intimate study in Chicago of 415 cases of reading disability and has reported his work in detail. His book should be consulted by any physician interested in this subject and also Orton's book on *Reading, Writing and Speech Problems in Children.*

You may casually wonder after all, why this whole problem is not purely a pedagogic proposition and may be somewhat of a psychiatric problem. If we pediatricians are responsible for the individual from birth to 21 years of age, this is another of the many worries with which we must be familiar and able to advise the parents and guide the child into the proper teaching channel. Boys are affected in ratio of three to one more than girls. The tragic outcome of the neglected children is delinquency of varying degrees. When the child has arrived at the age of from 12 to 14 years and has been passed from grade to grade on condition, he has a well-developed inferiority complex, a deeply disturbed emotional balance. The more so when his intelligence quotient measures up to the average or above. His pent-up feelings of rebellious self-respect at never being able to keep up in his work like the other children of his age or younger are sure to cause a life-long mental and emotional injury, creating in him an asocial individual and making him a plain wage earner when with his mental set-up he might have been a person of importance. The diagnosis and the treatment of this pediatric problem cannot be found in any pediatric textbooks or in any of our well-known systems on pediatrics; it can be ascertained only by special study and by experience.

Unfortunately there is no way of knowing what child is going to have difficulty in learning to read until he has been subjected to the test of learning for at least two years, which, of course, starts him with a bad handicap. But by the end of this period, the teacher and also the parent should realize that the child is unusual.

Most children have a hereditary tendency to develop the predominant use of the right or left half of the brain. Handedness, however, is so easily influenced by training that many children show a blending of hereditary tendency and the effects of training, with a resultant frustration in the form of stammering or reading disability. It is from the ages of 8 to 12 years that the peditrician is consulted.

The first requisite of the physician's examination is the intelligence quotient; then the correlation of this with achievement tests. The next step of importance is the careful history-taking of the child's sidedness. Then a few simple subjective tests should be made. In this regard, one should bear in mind that in the child with mixed motor dominance there may exist a marked degree of uncertainty. The same tests on different days may give diverse results. There may be a spontaneous shift from left to right dominance, or right to left, without any apparent external influence. This may appear at any age but occurs most frequently from 2 to 3 years and 6 to 8 years, which periods include the two important ages of word learning and language development.

In taking the history, first, of the child's early developmental period, the parent or anyone closely associated with the child at this time should be consulted. Also the child should be questioned as to his everyday hand uses. Ask him to show, if possible, his choice of hand in his everyday activities, as the use of a comb, toothbrush, eating utensils, baseball bat, saw, hammer, etc. Both types of history are necessary but also may be misleading. From the parent ask information on four points: (1) Whether there was any delay in hand choice beyond the period when the average child makes such a selection (usually this is from 18 months to 2 years); (2) whether any efforts were made to encourage or enforce the use of either hand; (3) whether the child manifested any unusual awkwardness in learning such tasks as buttoning his clothes, or tying shoe laces, or using his eating utensils; (4) when he first talked, as children with delayed or mixed cerebral dominance invariably start talking late, even up to the age of 4 years, or, if they start between 2 and 3 years, they are inclined to stammer or stutter.

Following this history-taking should come the sidedness tests which are nine in number, easily performed, and fairly conclusive. These are all suggested by Orton: (1) dynamometer; (2) have the child place pegs in holes, using each hand, or pick up Jack Straws or play Tiddledy Winks; (3) have him look through a peep hole in a card (place card on the desk; ask child to pick it up and look at some object through the hole); (4) have the child write on the blackboard two vertically parallel rows of figures up to seven, using right hand for one and left hand for the other (these may then be repeated with eyes closed); (5) give aiming tests, pointing tests, throwing tests (watch steadiness and precision of each hand, arm and shoulder); (6) have the child go up

steps (watch leg choice); (7) give the child tapping tests with pencil for twenty seconds, using each hand; (8) reading tests: reversing words as "was" for "saw," "on" for "no"; also reversing numerals; confusion of "b" and "d," "a" and "s," "t" and "f"; reversing letter sequence in two-syllable words; reading from right to left; (9) mirror reading.

The vision, especially fusion, should be tested and also auditory tests should be made if from the previous examination one is not sure that the laterality tests have proved anything. There are numerous borderline cases where the sidedness history and tests appear to be negative and yet the child has enough difficulty to require the special teaching. As to the advice regarding what should be done, there is only one method of approach in teaching such children to read; that is, by the auditory, or phonetic, method, supplemented by the finger, or the kinesthetic, method. Many of the children with severe cases and those with moderately severe cases should be taken out of school entirely for a year or more and given this special instruction by properly trained tutors. There are today some teachers especially trained to do such work, but most of the public and private school teachers do stereotyped teaching on the assumption that all children are the same pattern and can be made to fit into the school system by the usual means.

Possibly in the years to come, some progressive educator, with encouragement from the American Academy of Pediatrics, will institute in our Normal Schools for preparing teachers means by which the teacher may detect such children early and start the proper teaching method. However, at present and for a long time to come, I firmly believe this serious problem should be thoroughly understood by every practicing pediatrician so that he may prevent these cases of delinquency and bring happiness and peace of mind to the parents of such children.

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The Pediatrician and the War

The following government pamphlets have recently been issued which are of interest to those concerned with the health of children in wartime.

Protecting the Health of Young Workers in Wartime, Publication 291, U. S. Department of Labor, Children's Bureau.

A brief booklet of ten pages stressing the importance of and the problems of maintaining the health of young workers. It is estimated that about two million boys and girls between the ages of 14 and 18 were employed in October, 1942, or twice the number as in April, 1940. Over three million were employed during the summer vacation of 1942, and it is thought the number will be greater this summer. The importance of a physical checkup before employment, the avoidance of employment in hazardous jobs, the danger of overfatigue to the growing child, and food, health, and safety education are among the subjects discussed in the pamphlet.

Community Action for Children in Wartime, U. S. Department of Labor, Children's Bureau.

A plea for more widespread community action to extend the state and federal programs for aid to children in wartime. Such mechanisms for child care as the well-baby clinic—"a well-baby clinic in every community"—the care of children of employed mothers through day nurseries and foster home care, school care with school lunch programs in every school, play and recreation programs, employment safeguards, etc. are some of the items stressed as needing community action.

Standards and Recommendations for Hospital Care of Newborn Infants, Full Term and Premature, Publication 292, U. S. Department of Labor, Children's Bureau, 1943, Washington, D. C.

An outline of standards and technique for the care of the newborn in hospitals, adapted to war conditions which have led to a marked shortage of trained medical and nursing personnel. The danger to the newborn infant from overcrowding and inadequate staff is a serious problem in many hospitals and communities, and a problem that will become more serious the longer the war continues. The standards presented have been approved by three committees of physicians, including the Academy Committee on the Fetus and New Born Infant. Many suggestions to lighten the work in the nursery and at the same time to safeguard the health of the infant are presented such as, for example, omitting the bath for the first ten days and the use of auxiliary workers for certain duties. The bulletin, which was written by Dr. Ethel C. Dunham and Dr. Marion M. Crane, should be read by members of the nursing and medical staff responsible for the care of the newborn infant in every hospital. Copies (five cents) may be obtained from the Superintendent of Documents of the U. S. Government Printing Office in Washington.

American Academy of Pediatrics

Proceedings

Minutes of the Meeting of the Executive Board of the American Academy of Pediatrics

Chicago, Ill., June 5, 1943

The meeting of the Executive Board of the American Academy of Pediatrics was called to order at 10 A.M., June 5, 1943, at the Palmer House, Chicago, Ill. The following were present:

President: Borden S. Veeder
Vice-President: Franklin P. Gengenbach
Secretary-Treasurer: Clifford G. Grulee
Assistant Secretary: Edgar E. Martmer

Regional Chairmen:
Region I, Stanley Nichols
Region II, Hugh Leslie Moore
Region III, Lee Forrest Hill
Region IV, Hugh K. Berkley

Associate Regional Chairmen:
Region I, Warren W. Quillian
Region II, George F. Munns
Region IV, Vernon Spickard

The following applications for Fellowship were approved and the applicants elected to membership:

Region I

Adolph F. Bien, Sunnyside, Long Island, N. Y.
Henri J. Breault, Windsor, Ont., Can.
George R. Clammer, Reading, Pa.
Katherine Edgar, Bridgeport, Conn.
Norman Kendall, Philadelphia, Pa.
Herman B. Marks, Central Falls, R. I.
Irving S. Pearlman, Brooklyn, N. Y.
Albert A. Rosenberg, Poughkeepsie, N. Y.
William Rosenson, New York, N. Y.
Victor Rudomanski, Kearney, N. J.
John J. Shields, Philadelphia, Pa.
Richard H. Todd, Washington, D. C.
Ethel Walker, Baltimore, Md.
Myron E. Wegman, New York, N. Y.
James L. Winemiller, Great Neck, N. Y.
J. Andreas Wunderlich, Jr., Mt. Lebanon, Pittsburgh, Pa.
David Zahn, New York, N. Y.

Region II

J. Roberto Aguayo, Caguas, Puerto Rico
Laura C. Bickel, Houston, Texas
Edward W. Bulley, Vicksburg, Miss.
M. C. Carlisle, Waco, Texas
Julian Feild, Enid, Okla.
Louise F. Galvin, Richmond, Va.
Robert R. Harriss, Hollywood, Fla.
Frank R. Hopkins, Lynchburg, Va.
James G. Hughes, Memphis, Tenn.
Benjamin M. Kagan, Richmond, Va.
Winfred P. Killingsworth, Port Arthur, Texas
Edward L. Levert, New Orleans, La.
Joseph D. Russ, New Orleans, La.

Region III

Henry L. Barnett, St. Louis, Mo.
Olga Bonke-Booher, Indianapolis, Ind.
John H. Doval, St. Louis, Mo.
Joseph A. Forbrich, Oak Park, Ill.
Dorothy J. Jones, Clayton, Mo.
Herbert H. Liberman, Moline, Ill.
Irving Posner, Detroit, Mich.
Eli Rubens, Chicago, Ill.
H. Vaughn Scott, Fort Wayne, Ind.
Arthur L. Shafton, Chicago, Ill.
Edward W. Zeman, Hibbing, Minn.

Region IV

Osmund G. Bates, San Francisco, Calif.
Alvin H. Jacobs, San Francisco, Calif.
Gilbert M. Jorgensen, Los Angeles, Calif.
Charles W. Leach, San Francisco, Calif.
Robin M. Overstreet, Eugene, Ore.
Thelma Perozzi, Santa Barbara, Calif.
Harold E. Roe, Berkeley, Calif.
Kermit J. Ryan, Hollywood, Calif.
Robert G. Shirley, Beverly Hills, Calif.
Raymond J. van Wagenen, Fresno, Calif.

The following were elected to Emeritus Fellowship:

William M. Happ, Beverly Hills, Calif.
Philip S. Potter, Berkeley, Calif.

Dr. Antonio Ortiz was appointed Chairman for Puerto Rico.

Latin American Scholarships

At the present time, six Latin American physicians are studying in the United States. They come from the following countries:

3 from Mexico
1 from Venezuela
1 from Colombia
1 from Ecuador

These six physicians are taking their work at the following universities:

Harvard University
University of Pennsylvania
University of Michigan
University of Minnesota
University of Chicago
University of Iowa

Five condidates for scholarships have applications pending. The following countries are represented:

2 from Venezuela
1 from Chile
2 from Mexico

Four pediatricians have completed some study in the United States:

1 from Chile, 1½ years
1 from Cuba, 1 year
1 from Mexico, 1 year
1 from Panama, 6 months

Region V

Three applications from Panama, filled out and ready for approval, were presented to the Executive Board of the American Academy of Pediatrics, June 5, 1943, for consideration. The board approved the names and elected the following three candidates to membership in the Academy:

Leopoldo L. Benedetti
Pedro V. Nuñez
Edgardo Burgos

In addition, forty applications are pending from six South American countries:

Brazil has presented names of 8 outstanding pediatricions.
Chile mentions 12 men who desire membership.
Colombia will soon send in the applications of 7 doctors.
Ecuador has 2 candidates.
Peru sent the names of 9 pediatricians.
Venezuela suggests 2 possibilities.

A letter from the Commissioner of Health of New York City was read. This communication requested the Executive Board to give its opinion on the requirement of pasteurization of all certified milk entering New York City. After discussion, it was decided to send the following telegram:

> The Executive Board of the American Academy of Pediatrics is in favor of pasteurization of all milk as a first step in the protection of this food for infants.

Dr. Stanley Nichols presented the following Recommendations as to State Academy Activities under Present Wartime Conditions, requesting the approval of the Executive Board. It was suggested that these recommendations be carried out and they were heartily endorsed by the Executive Board.

> In view of the temporary suspension of National and Regional Meetings with their great values to Child Health, it seems important at this time that our State and Province Academy Fellowship should strive, under these difficult wartime conditions, to continue to make their contributions to the maintenance of child health in the Americas and to maintain the constitutional objectives of the Academy.

For these reasons the following recommendations are offered in the hope that the splendid progress of the Academy in the past toward better child health in the Americas at national, regional, state and fellowship levels shall continue at state and individual fellowship levels in spite of wartime handicaps.

It is suggested

1. That each State Chairman appoint a small State Committee of three to seven of his most able Fellows to meet with him at regular intervals of three to six months to study the wartime child health problems of the State and the role of the Academy Fellowship in the solution of such problems.

It is particularly suggested that the Chairman of the Child Health (or Public Health Committee) of the State Medical Society, the Chief of the Bureau of Maternal and Child Health of the State Health Department, and the Chairman of the Child Health and Welfare Committee of the State Office of Civilian Defense be invited to serve ex officio on this committee.

2. That this Committee, under the guidance of the State Chairman, study the special wartime child health problems peculiar to each state or province, as well as the general child health problems common to cities and provinces, such as Maintenance and Essential Pediatric Medical Care for Children, Evacuation and Reception Plans, Prevention and Control of Communicable Diseases Among Children, Health Supervision for Children of Working Mothers, Nutritional Programs, Child Health Problems in Military and Industrial Areas, Including the Problem of Adolescent Delinquency, School Health, Mental Hygiene, etc., and plan for State Academy Fellowship cooperation with other agencies and individual Fellowship participation in the solution of these child health problems.

3. That wherever possible an annual scientific and social meeting of the State Academy be held to include a general session where the State's wartime child health problems should be presented by the State Committee, with general discussion following. (In large states with two co-chairmen, it might be desirable that two meetings be held because of transportation or other difficulties.)

Perhaps by some such type of temporary wartime State and Fellowship Academy organization and activities as suggested above, the American Academy of Pediatrics, following this year of appraisal of wartime conditions, can continue its already outstanding contributions in its role against all of the enemies which threaten the good health of America's children.

Reports of Special Committees

Report of the Committee on Contact Infections

A luncheon meeting of the Committee on Contact Infections was held at the Palmer House, Chicago, Ill., Nov. 6, 1942. Dr. H. C. Sweany, President of the American Trudeau Society, was the guest speaker. He discussed the early detection of tuberculosis and expressed the hope that the American Academy of Pediatrics and his Society would work together with elimination of tuberculosis as a common objective.

Our Committee is not in accord with some of the statements on tuberculin testing of children in the booklet of *Therapeutic Procedures*. Suggestions for the modification of these ideas were submitted to Dr. John Toomey, Chairman of that Committee. It has been agreed that in the next edition of the pamphlet changes will be incorporated which conform to the ideas of both committees.

Recommendations for tuberculosis survey of the family units were approved by the Executive Board, and also by the Executive Committee of the American Trudeau Society. Details of this plan will be published in a forthcoming number of the American Review of Tuberculosis.

Dr. Park J. White has published an article on Prevention of Tuberculosis in the Newborn. Reprints of this will be distributed to members of the State Committee on Contact Infections.

Dr. Reginald Higgons recently represented the Committee in a nationwide radio address on the "Baby Institute Hour" under the auspices of the Academy of Medicine of New York City.

The Committee intends to continue with its effort along lines of prevention and early diagnosis of tuberculosis, with x-ray of mothers during pregnancy, the personnel of all hospitals, schools, and day nurseries.

Respectfully submitted,

Fairfax Hall, Chairman
Gaylord W. Graves
Reginald A. Higgons
Chester A. Stewart
Park J. White

Report of the Committee on Cooperation With Nonmedical Groups

The chief function of the Committee so far this year has been in cooperation with the National Association for Nursery Education. At the request of the nursery school group a statement has been prepared by the Committee dealing with the benefits of a good nursery school. In conjunction with the Educational Department of the Metropolitan Life Insurance Company and the National Association for Nursery Education, a question and answer pamphlet is being prepared. This will deal with the health problems that have been raised by the nursery school teachers and the parents of nursery school children. This will be published by the Insurance Company subject to the approval of the Academy.

The previously established contacts with the National Congress of Parents and Teachers are being continued.

Respectfully submitted,

Albert D. Kaiser, Chairman
Dennis H. Kelly, Secretary
James W. Bruce
George L. Drennan
Marvin Israel
Joseph I. Linde
Margaret Nicholson
James C. Overall
Lillian R. Smith

Report of the Committee on Fetus and Newborn

The Committee on Fetus and Newborn of the American Academy of Pediatrics was able to hold no stated meeting during the past year. Certain work has been carried on by means of correspondence, the most important of which has been the study by individual members of the Committee of a new publication the Children's Bureau is about to issue entitled *Standards and Recommendations for Hospital Care of Newborn Full-Term and Premature Infants.*

The various members of the Committee gave considerable time to studying these standards and made specific recommendations to the Children's Bureau. Judging from communications from the Children's Bureau, this cooperation was appreciated.

The Committee wishes to recommend these public standards and to suggest that on publication copies be submitted to all members of the American Academy of Pediatrics.

Respectfully submitted,

Stewart H. Clifford, Chairman
Wyman C. C. Cole
Laurence R. DeBuys
Ethel C. Dunham
Arthur H. Parmelee
Bret Ratner
Mitchell I. Rubin
Ralph M. Tyson

Report of the Committee on Legislation

The only item of Federal legislation considered by the Congress since the last report of the Committee on Legislation which possesses an especial interest to the members of the Academy has been the recent passage of an Act appropriating funds for the care of the wives and children of members of the Armed Forces below the grade of commissioned officers. This legislation provides certain appropriations to be administered by the Children's Bureau of the U. S. Department of Labor for the prenatal and maternity care of wives and for the general care of infants up to the age of 1 year for the duration of the war as well as through a period of six months after its conclusion.

This legislation received the endorsement of the Academy at its last general meeting in November, 1942.

The Chairman of the Committee, because of residence in Washington, has frequently been in personal touch with various federal officials and with some of the officers of the larger evaporated milk companies, in an effort to secure the release of larger quantities of evaporated milk stores for use in infant feeding. Contact has also been had with officials of the Office of Price Administration regarding the pack of infant vegetables and fruits in the adequate production of which the Academy expressed its interest at the last annual meeting.

Respectfully submitted,

JOSEPH S. WALL, Chairman
JAY I. DURAND
HARVEY F. GARRISON
PHILIP VAN INGEN
ALFRED A. WALKER

Report of the Committee on Pan-American Scholarships

Since January of this year, four Latin American scholars have come to this country to begin their studies in Pediatrics. They are three scholars from Mexico: Dr. Joaquin de la Torre, who is at the University of Pennsylvania; Dr. Jose A. Novo Segura, University of Minnesota; and Dr. Oscar Trevino Narro, University of Iowa; the fourth scholar is Dr. Jorge Vallarino D. from Ecuador, who has just recently begun his work at the University of Michigan.

Members of the scholarship committee in Chile have appointed Dr. Eduardo Cassorla as their next pediatric scholar. He is planning to come to the United States in the near future.

In the meantime, we have contacted the Los Angeles Children's Hospital and the Department of Pediatrics of Duke University and are pleased to be able to report that the heads of both departments are willing to accept a Latin American scholar.

The Committee has decided that it would be well to include Puerto Rico in the scholarships of the Academy.

Respectfully submitted,

HENRY F. HELMHOLZ, Chairman
SAMUEL Z. LEVINE
FREDERIC W. SCHLUTZ
FRANCIS SCOTT SMYTH

The Committee on a Library and Museum of Pediatrics reports progress.

Report of the Committee on Mothers' Milk Bureaus

The Standards for the Operation of Mothers' Milk Bureaus, which were mentioned in the last annual report of this Committee, have now been completed and submitted to the Executive Board of the Academy for possible publication.* These

*This report appears in full on p. 112 of this issue.

should be most helpful to organizations at present collecting and dispensing human milk and to groups setting up such bureaus.

The Committee still feels that all the members of the Academy should use every opportunity to advocate the breast feeding of infants. In times such as these there is a scarcity of women able to sell their milk through Directories and an increase in the demand made upon such agencies for breast milk to feed premature or sick infants whose mothers are unable to nurse them. Finally, it should be noted that any mother who nurses her own baby is thereby making a similar amount of cow's milk available to some other child.

Respectfully submitted,

CLEMENT A. SMITH, Chairman
CARL H. LAWS, Secretary
JULIUS HESS
E. EARL MOODY
WILLIAM J. ORR
ARTHUR G. QUINN

Report of the Committee on National Defense

Since its organization, your Committee has had activities along a number of lines, for the most part handled by subcommittees. A subcommittee dealing with the relationship of pediatricians to the Armed Forces has been under the chairmanship of Dr. Joseph Stokes, Jr. The necessity for this committee was largely cancelled by the activities of the Bureau of Procurement and Assignment, and Dr. Stokes states that there is nothing to report at this time.

Activities in connection with government agencies having to do with child nutrition and cooperation with the Children's Bureau are under the chairmanship of Dr. Joseph S. Wall. He reports that he has had various contacts with officials of the Office of Price Administration and the Food Administration relative to the shortage of evaporated milk, a report of which he is submitting direct because it also comes within the scope of the Academy's Committee on Legislation, of which he is Chairman.

The main activities of the Committee have had to do with the care of refugee children. Your Chairman has continued as a member of the Advisory Committee for the care of a large group of British children for whom both individually and collectively there has been some activity. The principal interest, however, has been in cooperation with the United States Committee for the Care of European Children in efforts to bring over additional refugee children from the European continent. At the time of the National Meeting of the American Academy of Pediatrics in Chicago, November, 1942, an escort party was being sent to Lisbon with the original purpose of bringing back 1,000 children on a Portuguese boat. Less than a week before the sailing date, word was received that only 500 children would be permitted to leave France, and the escort party was cut from about thirty-six, including eight doctors, to about twenty-six, including five doctors, of whom Dr. Katherine Dodge, of New York City, was Chairman, the other doctors being Dr. Christine Einert, surgeon, Dr. Margaret Schaffner Tenbrinck, Dr. Dorothy Jackson, and Dr. Rosa Frank. This escort party sailed only a few hours before news was received that the American Expeditionary Force had landed in Africa, and accordingly when the party reached Lisbon, it was found that the Spanish-French frontier had been closed and the children who were originally planned and assembled by the Friends Service Committee for evacuation to America had been prevented from leaving France. After about a month's stay in Lisbon, the party did succeed in assembling thirty-one continental refugees and brought them back on a Portuguese boat, eventually arriving on January 26. Very careful and detailed reports about supplies, traveling conditions, and health conditions were submitted by Dr. Dodge, so that valuable information was obtained from this trip, even though the number of

children brought to America was very few. On March 14 twenty-one more refugee children were brought in by the United States Committee, with escorts provided in Europe, and an additional thirty-five arrived April 30. In the summer of 1942, two more small groups, one of fifty and one of thirty-eight, were brought over. For all these groups, during their one- to two-week observation stay in the vicinity of New York City, medical examinations and care were provided by pediatricians organized by Dr. Carl H. Smith. Among the doctors who assisted in this work were Drs. Katz, Turner, Archie Cohn, Blazenstein, and Pasachoff, and, in particular, Dr. L. H. Barenberg. Dr. Carl Smith has done a great deal of work in this connection, and it is hoped that the Executive Board of the American Academy of Pediatrics will add him to the membership of the Committee on National Defense.

It is anticipated that small groups of children will continue to be brought over at irregular intervals with escorts provided from adult refugees waiting to come to America. The United States Committee for the Care of European Children is having more and more difficulty finding housing facilities for the ten- to fourteen-day period of observation given these children on arrival. Most of the recent groups have been housed in the Bronx, but the current group is going to a place in Pleasantville, N. Y. The help of local pediatricians in new communities may yet be needed.

Respectfully submitted,

PHILIP M. STIMSON, Chairman
DR. KATHERINE BAIN
DR. ROBERT A. BIER
DR. ALLAN M. BUTLER
DR. HARRY H. DONNALLY
DR. CARL H. LAWS
DR. DOUGLAS D. MARTIN
DR. RUSTIN MCINTOSH
DR. EDWARDS A. PARK
DR. W. H. SEBRELL
DR. LENDON SNEDEKER
DR. JOSEPH STOKES, JR.
DR. JOSEPH S. WALL

Dr. Carl H. Smith, of New York City, was appointed to the Committee on National Defense.

The following Committees had nothing to report:

Committee on Camps
Committee on Governmental and Medical Agencies
Committee on School Health
Committee on Honorary Fellows
Committee on Hospitals and Dispensaries
Committee on Immunization and Therapeutic Procedures for Acute Infectious Diseases
Committee on Medical Education
Committee on Mental Health
Committee on Nursing Education
Council for Pediatric Research
Committee on Geographical Distribution of Pediatricians

Dr. Veeder reported that at a conference at Indianapolis with the American Legion officials, it was agreed that the Academy would pass on anything in their program pertaining to feeding and nutrition, but so far as child psychology was concerned, we did not feel that that was within our province. Up to date, nothing further had been heard regarding their program.

Mead Johnson & Company has decided to drop their project of a film on nutrition for the time being.

Dr. Franklin P. Gengenbach read a letter from Dr. E. C. Mitchell requesting that permission be given the American Legion to publish the *Child Health Record.* It was moved and carried that permission be given the American Legion to publish this pamphlet for distribution with the approval of Dr. Fairfax Hall and of Dr. Harold Stuart, who furnished the weight chart contained in this pamphlet.

At the request of Dr. Hugh McCulloch, Dr. Borden Veeder asked the reaction of the Executive Board toward the book exhibit and supplement to THE JOURNAL OF PEDIATRICS which has been published for several years. He asked if the Academy would be willing to take on the expense of this at sometime in the future. The Executive Board stated that it was heartily in favor of continuing the book exhibit and supplement, but at the present time it could make no commitments regarding expenditures for this purpose.

Dr. Borden Veeder reported on the plans for postwar work in Europe with the cooperation of the British Pediatric Society, and Dr. Clifford G. Grulee gave an outline of the work of the Subcommittee on Maternity Care and Child Health.

After due consideration of the proposition regarding "The Baby Institute," Blue Network radio program, it was decided that the Academy could not sponsor this broadcast under present conditions.

Owing to illness, Dr. Ernest Caulfield was forced to resign as Historian. His resignation was accepted with great regret and it was decided to postpone the appointment of his successor pending further information as to the one most available.

The question of publishing an *Annual Meeting Number* of THE JOURNAL OF PEDIATRICS was referred to a committee consisting of Dr. Clifford G. Grulee, Dr. Edgar E. Martmer, and Dr. Borden Veeder.

After much discussion of the situation of canned foods for infants, it was decided to send the following resolution of the OPA, Food Price Division Director:

> The Executive Board of the American Academy of Pediatrics in executive session at Chicago, Ill., June 5, 1943, respectfully submits the following resolution concerning the future availability under wartime rationing of certain foods considered essential for infant nutrition; namely, (1) canned strained vegetables, (2) canned strained meat and vegetable soup, and (3) canned stewed fruits:
>
> WHEREAS, the maintenance of an optimum standard of health for the infants and children of America is of paramount importance to the future welfare of the nation, and
>
> WHEREAS, The use of these foods is assuming ever greater importance in the safe feeding of infants, and
>
> WHEREAS, The purchase of these foods by and for the use of adults threatens the supply available for infants,

BE IT RESOLVED That the sale of these products be restricted for the use of infants under 18 months of age, with the possible exception of certain types of invalids whose special needs could be certified to by a qualified physician.

BE IT FURTHER RESOLVED That since the average daily requirements respectively of these foods for infants under 18 months of age is approximately

(1) One can of strained vegetable, or meat, and vegetable soup

(2) One can of stewed fruit

In addition to a proper allowance for fresh meat, fats and oils, that sufficient ration points to meet such requirements be allocated all children under 18 months of age.

The expenses allowable for State Chairmen were then discussed and the following arrangement was approved by the Executive Board: The Academy will reimburse each State Chairman for sums expended for postage. Stationery and mimeographing can be obtained by arrangement with the Secretary. Any other expense must be submitted to the Regional Committee as an estimate in advance and approval of the Regional Committee obtained before incurring the expense. There are no exceptions to the rule.

After considerable discussion, it was decided not to hold a general meeting of State Chairmen.

Since it had been suggested by the Nominating Committee that the present officers of the Executive Board remain in office for the duration of the war since there would be no annual meeting, the legality of such a plan was discussed. It was the consensus of opinion of the Executive Board that election of officers should occur even though there would be no regular annual meeting. The Nominating Committee should be requested to send in their nominations at the earliest possible date. These nominations are to be sent out to the membership with the request that they make any other nominations they desire. If there are as many as fifty nominations for any one member, his name will appear on the final ballot. The final ballot will be sent out with the names collected in that way, in addition to the nominations of the Nominating Committee. In addition to the final ballot, a statement will be included to the effect that in order to meet the requirements of the Constitution, a meeting will be held on a certain date for the purpose of election of officers. If a member is unable to attend, a prepared proxy should be returned.

The first Saturday of November was suggested as the probable date for the next Executive Board meeting.

RECOMMENDED STANDARDS FOR THE OPERATION OF MOTHERS' MILK BUREAUS

I. Foreword

The function of Mothers' Milk Bureaus is to collect the surplus milk of healthy mothers and distribute it for the use of sick and premature babies.

One of the chief advantages of such services is that a central collection and distribution station makes it possible for doctors and hospitals to obtain, without delay, a safe supply of mothers' milk in sufficient quantity with uniform sugar, fat, and protein content.

Mothers' Milk Bureaus necessarily function under varied conditions. In highly populated areas, the mothers may come to the central office of the Bureau for pumping or expression of their milk; in more extensive metropolitan areas the milk may be collected more effectively from the mothers at their homes. Standards for Mothers' Milk Bureaus operating under the latter circumstances were prepared in 1939 by Cornelia MacPherson, R.N., and F. B. Talbot, M.D. So adequately did they cover this aspect of the subject that considerable sections of those Standards have been incorporated into the presentation which follows. It is believed that there are now sufficient accepted practices to warrant the adoption of the Standards and methods which, by experience, have proved to be useful and practical for all types of mothers' milk collecting and dispensing. This guide is presented as an ideal toward which to strive in the operation of Mothers' Milk Bureaus.

II. Organization

The organization and administration of Mothers' Milk Bureaus depend upon the widely varied conditions under which they operate.

Every Mothers' Milk Bureau should have a Medical Advisory Committee. When the service is an integral part of a hospital or other social agency, the only additional organization which may be necessary is a Medical Advisory Committee. Mothers' Milk Bureaus attached to maternity hospitals having a maternity service may draw upon the staff of the Pediatric Department for committee members.

Independent Mothers' Milk Bureaus should be formally organized and incorporated under the laws of the State in which they operate. Their Medical Advisory Committee should be made up of physicians specializing in pediatrics. It would also be advisable to have a representative of the nursing profession and a representative of a social service organization on the committee. One member of the committee should be a recognized authority on milk sanitation. It should be the responsibility of the committee to determine the policy in regard to the collection, pasteurization, storage, and distribution of mothers' milk.

All Bureaus must comply with the regulations of the local health department. If the health department has not promulgated regulations covering the operation of Mothers' Milk Bureaus, the committee should assist in the preparation of such regulations.

It should also be the responsibility of the Medical Advisory Committee to promote breast feeding and to interest itself in all programs of maternal and child welfare.

Presented by the Committee on Mothers' Milk of the American Academy of Pediatrics from material collected in a survey by the Children's Welfare Federation of New York City in cooperation with the Mothers' Milk Bureaus throughout the country.

A lay committee will be of value in fostering good community relationships and in publicizing the importance of breast feeding in reducing infant mortality, particularly among premature infants.

Mothers' Milk Bureaus, if they are to give infants of the medically indigent the advantages of mothers' milk, will require financing. The raising of the necessary funds should be one of the functions of the lay committee.

III. Personnel

A. Professional Staff.—The professional personnel employed in the operation of Mothers' Milk Bureaus should be registered professional nurses with public health training. They must have maturity of judgment, administrative ability, and the capacity to get along with people. Their background of education and experience should fit them to be scrupulous in their approach to the technical requirements of the service.

B. Nonprofessional Staff.—Much of the routine work of Mothers' Milk Bureaus can be handled by nonprofessional workers, provided such workers are well trained in the duties required and understand the principles of aseptic technique, hygiene, and sanitation involved in their work. It is recommended that all personnel be permanently assigned to this department.

C. Staff Education.—It is important for the professional staff to be alert to the changing trends in their profession. It is suggested that time be allowed the professional workers for educational purposes and contact with other organizations.

D. Health of Staff.—

1. A thorough physical examination including
   Nose and throat cultures
   Serologic test
   Chest x-ray
   Vaginal smear } Optional if milk is to be pasteurized
   Stool examination }

should be required on all staff (a) before employment; (b) after sick leave, depending upon the nature of illness; (c) at the discretion of the director.

2. At least once each year the routine physical examination should include a minimum of serologic test and chest x-ray.

3. The report of the medical findings and the laboratory tests should be in writing and on file at the Bureau.

IV. Milk Donors

A. Selection.—A satisfactory way to obtain milk donors is through such hospitals as can refer healthy mothers who have been under recent observation. Physicians, visiting nurses, health services, and social agencies are also contacts through which donors may be secured.

B. Compensation.—Regular milk donors should receive compensation sufficient to insure good standards of living and relief from financial worry.

Payment to the milk donor is usually a stated amount per ounce for the milk contributed. It is recommended that donors be given milk or other nutritious liquid after the expression of milk.

C. Social and Medical Requirements.—

1. A satisfactory health history and physical state, free of infection is required of the donor. She must have a general physical examination made by a physician designated and paid for by the organization, which should include:

   X-ray of the chest and heart
   Sputum test
   Nose and throat cultures

Vaginal smears when indicated
Serologic test to be repeated every six months

This examination should be made before the mother is accepted as a donor, and also after any illness. The facilities of the local health department should be used where indicated or necessary.

2. A health history of the family is important to eliminate as donors contacts to persons who have tuberculosis or venereal diseases.

3. A satisfactory report of a home visit by a member of the professional staff is necessary in order to get a picture of the economic and health situation in the household of the milk donor.

4. The donor should be successfully nursing her own baby. She may be accepted at any time in the postpartum period and continue as long as she has a satisfactory milk supply and is free of infection or other illness. A nourishing diet, properly balanced as to vitamins, minerals, and protein, is required.

The donor must satisfactorily maintain her own and her baby's physical health. The baby should be under the continuous medical supervision of a private physician or child health service to make sure that the donor's milk contribution is not disadvantageous to her own baby. The weight of the baby should be taken every two weeks until 6 months of age and once a month thereafter. In the event of loss of weight of the baby, the donor should be suspended until normalcy is regained. Any contagious disease in the family stops the collection of milk during the time of such contagion.

5. Reports of all medical examinations, home visits, and laboratory findings should be in writing and filed with the current record of the donor.

6. A continuous record of the physical condition of the baby, including its weight, should be kept on file.

D. Health Education.—Provision should be made in the program for the nurse to have individual conferences with the donors to discuss personal problems which may affect her well-being. Regular group discussions should be held on topics of general interest.

Periodic home visits must be made by the nurse. This gives an excellent opportunity to supervise the health and welfare of the donor and her family and to check upon the required technique.

V. Collection of Mothers' Milk

A. Place of Expression.—

1 Hospital: A Mothers' Milk Service operated in connection with a hospital collects the surplus milk from patients during the lying-in period. It is the usual practice to use this milk for the sick or premature babies on the hospital service.

In some instances the milk is collected after the patient leaves the hospital, either from the home or by the donor returning to the hospital for the expression.

2. Stations: A Bureau which requires milk donors to go to a central station should be located at a convenient and accessible point. The majority of such service units require the milk donor to come to the station once a day for the expression of her surplus breast milk. More than one trip a day is discouraged because of the resulting fatigue and inconvenience to the donor.

The expression of milk at a central station should be so organized that constant supervision is given the donor during the preparation for and the expression of milk in order to prevent contamination or dilution of the milk.

3. Home: When transportation to a central station is difficult, the milk may be expressed in the home. The home must be clean and sanitary. Refrigeration is required winter and summer. The milk is kept for twenty-five hours in the refrigerator near the coils or cakes of ice. The temperature of the refrigerator must not at any time rise above 40° F. The milk is delivered once daily to the

station in iced containers by the donor or collected by the nurse. On such visits to the home, the nurse checks upon the technique used in the expression of milk. Adequate sterile containers which can be properly sealed shall be furnished for the milk by the Bureau as well as galvanized or tinned containers which can be properly iced when the milk is transported to the station.

B. Preparation of the Donor—All Methods of Expression.—The basic principles are as follows:

The donor's outer clothing should be removed and replaced by a clean gown of washable material.

A cap should be worn so as to cover the hair completely.

A mask should be worn to cover the nose and mouth.

Scrubbing is an important factor in preparing for milk expression. The hands and forearms should be brush-scrubbed for three minutes with soap and running water.

After the first scrubbing the nails and nail beds are cleansed with an orangewood stick, soap, and running water.

Next, the breasts and surrounding chest area should be washed thoroughly with cotton, liquid soap, and running water for three minutes.

The nipple and areola should be cleansed with sterile cotton and water immediately before beginning the expression.

C. Methods of Expression.—Four methods of expressing milk are recommended: hand pump, water breast pump, electric breast pump, and manual expression.

Both breasts are emptied at each expression. All apparatus coming in contact with the milk or breasts must be sterilized by autoclave or boiling each time before use. After use it is rinsed and washed in soapy water.

All milk pumped or expressed is poured into a sterile container which can be adequately sealed and immediately held in refrigeration below 40° F. until delivery or pooling and pasteurization. All milk that is not processed (pasteurization or preservation) within forty-eight hours of production shall be discarded.

1. Hand Breast Pump: The breast pump should be applied very gently over the nipple or the delicate tissues may be injured and trouble result.

The use of the breast pump should never, at any time, be painful to the mother.

In some cases it will be found necessary to combine massage of the breast with the use of the pump; and if the milk does not flow freely when the pump is used, the breast should be stroked gently and firmly with the finger tips from the edges toward the nipple.

Both breasts should be emptied at each feeding time, and the milk should be poured into a sterile receptacle often enough to prevent overflow of the collecting chamber.

2. Water Breast Pump: The adaptor of the breast pump is connected to the cold water faucet. The water is turned on slowly, gradually increasing the pressure.

The breast pump is held in the left hand in such a position that the shield covers the nipple.

The right hand is used for controlling the vacuum which the flow of water creates by working a finger up and down over a hole in the glass shield.

3. Electric Breast Pump: The nipple shield should be placed on the breast while the machine is running, pointing the nipple directly into the center of the shield. If the nipple is drawn toward the side of the shield, part of the milk ducts are obstructed by the glass, and the milk cannot flow freely.

After letting the machine run at 2″ for a few strokes, to accustom the nipple to the pulling action, the suction is gradually increased by turning the regulating valve slowly to the right until the dial shows about 5″ or 6″ of vacuum. The milk will begin to flow after about five seconds of pumping at this suction which is slightly less than that produced by a healthy infant. In the majority of cases

a suction of from 6″ to 8″ of vacuum will empty the breast completely in from six to twelve minutes.

When the milk ceases to flow, take the shield off and compress gently to the base of the breast, one sector at a time. Then apply the shield to the nipple again and the machine will strip the breast.

Before placing the machine on the other breast, reduce the suction again to 2″ of vacuum and then proceed as described above.

4. Manual Expression: As the human nipple contains no storage reservoir, the mother expresses, rather than draws off, the milk. The first two fingers are placed below and the thumb above the edge of the pigmented areola.

Next, she exerts pressure upon the areola with a firm but gentle follow-up action converging at the base of the nipple, and coaxes the milk out.

This process is repeated from thirty to sixty times a minute. Each compression forces the milk into the sacs and through the nipple, each time producing a vacuum within the sac which is immediately filled with milk as frequently as the vacuum is produced. The milk is expressed into a wide-mouth sterile receptacle.

VI. Plant and Equipment

A. General Considerations.—The space used for the handling of mothers' milk should be light and air-conditioned or well ventilated with filtered air, and/or free of dust. All openings should be effectively screened, and doors should be self-closing. The walls should be finished with a washable paint and cleaned periodically. The floors of all rooms in which milk is handled or stored or in which milk utensils are washed should be of impervious, easily cleaned material. Furniture should be of material which can be scrubbed. Metal or stainless steel is preferable for the basic equipment such as sterilizers and sinks.

B. Required Rooms and Equipment.—

1. Room for the washing and sterilization of articles and for the bottling, capping, pasteurization, or boiling of milk.

Equipment:

- Combination bottle sterilizer and pasteurizer, heated by gas, or steam, should be equipped with racks and a thermometer. If such equipment is not obtainable, a deep cooking pan with a rack and a separate thermometer may be substituted.
- Autoclave
- Water sterilizer or tea kettle
- Stove
- Work table
- Stool
- Refrigerator with thermometer
- Ice chest for water-ice used for packing orders
- Bottle capping machine equipped so that cap will cover the pouring lip to at least its largest diameter
- Sink with running hot and cold water
- Liquid soap dispenser
- Clock
- Waste receptacle
- Paper towel box
- Paper drinking cup dispenser

Supplies:

- Milk bottles
- Bottle caps
- Graduated glass beakers

Bottle brushes
Paper towels
Paper drinking cups
Tin containers with lids, Paper bags } for delivery of orders packed in water-ice
Bottle openers
Marking crayon
Shipping tags
Liquid hand soap
Cleaning powder and cloths

2. Dressing Room and scrub area of a central station; Room in which donor removes outer clothing, dons uniform, cap, and mask and prepares for milk expression.

Equipment:

Drawer lockers for donors' personal articles
Coat and dress racks with hangers
Sink having running hot and cold water
Liquid soap dispenser
Paper towel box
Paper drinking cup dispenser
Waste receptacle

Supplies:

Face masks
Liquid soap
Hand scrub brushes
Orangewood sticks
Absorbent cotton in covered container
Paper towels
Paper drinking cups

3. Lavatory and toilet facilities; the toilet room should not communicate directly with any room used for the handling of milk. It should be adequately ventilated and lighted and have a self-closing door.

Equipment:

Hand-washing facilities with running hot and cold water
Toilet
Liquid soap dispenser
Paper towel box
Toilet tissue holder or roller
Liquid soap
Paper towels
Toilet tissue

4. Milk expression room; this room should be adequately lighted and air-conditioned or ventilated with filtered air, and/or free from dust.

Equipment:

Booths of metal or wood and glass
Chair and footstool in each booth
Sink having running hot and cold water
Liquid soap dispenser
Clock to time duration of expression period
Paper towel box
Waste receptacle
Daily record sheet of donors' names and ounces of milk collected
Table for the necessary equipment

Graduated glass beakers into which donors express their milk
Calibrated glass beaker with cover for measuring ounces of milk when received from each donor
Covered jar containing absorbent cotton } used for cleaning nipple and areola
Bottle with rubber cap containing sterile water }
Pooling machine or a covered glass container for pooling of milk as collected, if the latter is used the container must be placed in a vessel containing sufficient cracked ice for immediate chilling of milk as collected

5. Additional space; sufficient office space should be allocated for privacy in interviewing the prospective donors, for conferences, and for records; an area should also be set apart for the reception of clients and the distribution of the milk.

Equipment:

Nurses' desk and chairs
Desk equipment
Files

C. Home Unit.—Where milk is collected in the home, any one of the four techniques of expression may be used. It must be stressed, however, that the same sanitary safeguards be used in the home both before and after milk expression.

VII. Handling of Milk

A. Sterilization of Utensils.—All glass graduates, bottles and other articles used in the handling of milk must be thoroughly sterilized, preferably by dry sterilization. When this method is employed, glassware and dry goods should be autoclaved for fifteen minutes under pressure of eighteen pounds, at a temperature of 257° F. Rubber goods should be autoclaved for ten minutes under pressure of 18 pounds, at a temperature of 257° F.

When the method of wet sterilization is used, the articles should be first cleansed by rinsing in cold water, then brush-scrubbed with soap and water, rinsed under running water, sterilized at a temperature of 212° F. for ten minutes, drained, and then allowed to dry.

B. Pooling and Chilling.—Care should be taken that the duration of the expression period be kept at a minimum and that the milk is not unnecessarily exposed. After expression, the milk should be immediately chilled to a temperature of 40° F. The milk collected from the various mothers should be pooled and agitated in order to insure a uniform chemical content.

C. Pasteurization of Milk.—The milk is bottled according to the daily orders covering the individual needs of each baby. The bottles are placed in racks in the sterilizers. Cold water is brought up to the necks of the bottles. The temperature of the water is brought up to 145° F. and held there for thirty-five minutes. Cold water is then allowed to flow into the sterilizer, lowering the temperature of the milk to 40° F., within thirty minutes. During the cooling of pasteurized milk the bottle should be inverted frequently to homogenize the milk and prevent butterfat from clumping. The milk is placed in the refrigerator and kept at 40° F., ready for distribution.

D. Preservation of Mothers' Milk.—In order to equalize the supply and demand, some method should be employed for preserving the surplus maternal milk. Those now in popular use are the quick-freezing, the slow-freezing, and the fractional sterilization methods.

1. *The Quick Freezing Method* was perfected and patented by the Borden Company of New York City in 1932 and is in use by many Bureaus throughout the country. Any agency desiring to use this method must obtain permission and the equipment (plates) from this company.

Sterile Equipment:

1 aluminum plate or mold 10 inches square with 16 depressions, each ⅓ fluid ounce capacity
1 plain aluminum plate 10 inches × 5 inches with a handle
1 16-ounce glass beaker
1 4-ounce asepto bulb syringe
16-ounce glass mason jars with rubber rings and lids
2 teaspoons
2 gauze sponges
3 sterile towels

Unsterile Equipment:

Metal-top table
Quilted pad to protect table top
3 blocks dry ice:
1 10 by 10 by 5 inches
2 10 by 5 by 5 inches
Date tags, 1 inch square
Storage refrigerator set at −15° F.

Procedure:

Milk is collected and pasteurized in the routine way.
The equipment is sterilized by boiling for ten minutes.
Operator wears gown and mask; hands and arms are scrubbed five minutes.
Table is covered with quilted pad and sterile towels.
Blocks of dry ice are assembled in a level position.
An aluminum mold is placed on flat surface of dry ice 10 by 10 by 5 inches.
Depressions on ½ of plate are filled with pasteurized cold milk by means of asepto syringe.
Mold containing milk is covered with small plate holding dry ice.
Depressions on other half of mold are filled with milk.
In about two minutes a clicking noise denotes that the milk on the first half of the place is frozen in wafers and separated from the mold.
Place small cover plate holding dry ice over other half of plate containing liquid milk.
With teaspoons transfer the frozen wafers of milk to the glass mason jar which is kept on blocks of dry ice 10 by 5 by 5 inches.
When jar contains specified number of ounces it is sealed and placed in storage refrigerator and kept at a temperature of −15° F. for an indefinite period.
Frozen milk can be liquefied by immersing the jar in cold tap water; by allowing it to stand at ordinary room temperature; or by placing it in an icebox for a period of time. After being melted down, the milk should be used within twenty-four hours.

2. *Slow Freezing Method.* Pasteurized human milk may be placed in sterile mason jars and allowed to freeze at any temperature below −7° C. (18° F.), which can usually be provided in the hardening compartment of an ice cream-making machine such as is used in the kitchen of most large hospitals. Eight- or sixteen-ounce jars may be used, though they should not be filled quite to capacity because of the expansion of the milk during the process, and the cap should not be tightly screwed down until freezing is complete. After the milk is solidified, the jar should be sealed with its glass lid and rubber ring, wrapped in paper, labelled, and placed in storage. Such silk may be shipped in frozen form if packed with sufficient dry ice to insure it against thawing.

3. *Fractional Sterilization* of mothers' milk was in use before the above methods were introduced. It is employed where dry ice is not available.

Sterile Equipment:

8-ounce formula bottle
Cork
Gauze, 6 thicknesses
Waxed paper, 2 pieces
Elastic band

Unsterile Equipment:

Thermometer
Double boiler containing rack for holding bottles
Paraffin
Date tags

Procedure:

Pour 7 ounces of unpasteurized breast milk with ½ ounce of sterile water into an 8-ounce sterile formula bottle.
Place sterile cork in bottle but do not push down tightly.
Place six layers of sterile gauze over cork and then a piece of waxed paper. Secure this with a large rubber band.
Place bottles in a bottle rack.
Place bottle rack in the top of a double boiler on a wire mat in cold water that reaches the level of the milk in the bottles.
The water is maintained at a temperature of 175 to 180° for thirty minutes. (Care should be used not to overheat milk as it will caramelize.)
Remove bottles from double boiler and cool to room temperature and place in refrigerator as soon as cool.
At the end of another twenty-four-hour period, repeat the process.
Following the third heating, tighten corks in bottles.
Cool bottles.
Seal top of bottle with paraffin to make it absolutely airtight.
Milk preserved by this method should be stored at a temperature of 40° F. and may be kept as long as two years.

E. Refrigeration and Storage of Mothers' Milk.—All space used for refrigeration should be kept scrupulously clean. Liquid pasteurized milk should be stored at a temperature of 40° F. and may be kept on hand at this temperature for twenty-four hours before freezing (note).

When sufficient space and equipment are not available on the premises for storage of excess preserved milk, arrangements may be made with some commercial organization having refrigerating facilities, providing they comply with the Sanitary Code of the locality and provide a constant and satisfactory temperature. Frozen milk should be kept at a constant temperature of –10° F.

F. Bacteriologic Examination and Chemical Analysis.—Samples of the raw, pasteurized, and preserved milk for bacteriologic examination and chemical analysis should be taken periodically or as required by the community board of health. It is recommended that this be done monthly. The bacterial count of raw milk should not exceed 5,000 colonies per cubic centimeter. Pasteurized milk and preserved milk should not exceed 10 colonies per cubic centimeter. The phosphatase test is recommended for adequate pasteurization. Chemical analysis should consist of examination for total solids and fats.

Where possible, some bacterial check should be made on milk of individual donors.

When milk is collected from the home, examination is necessary at least once weekly and frequent tests should be made to detect dilution of the milk.

G. Tests for Adulteration.—If milk is collected from the home, some check must be made as to dilution with water or with the milk of some other species. The addition of water to milk is not easily detected; all methods necessitate measurement of the fat content of a sample by the standard Babcock test. This procedure (described in Standard Methods of the Examination of Dairy Products, ed. 7, New York, 1939, American Public Health Association) is so complex and requires such specialized equipment that much time and effort may be spared if dubious samples of breast milk can be analyzed by a dairy laboratory regularly dealing with cow's milk. The percentage of fat, when determined, must be plotted against the specific gravity of the milk (as determined by a milk hygrometer) upon a chart such as the one devised from Strom.

A formula which does away with plotting these values on a chart is as follows:

$$\frac{\textit{Lactometer}}{4} - 1.2 \text{ fat} = \text{per cent of total solids.}$$

Per cent of total solids—per cent of fat—per cent of solids not fat. ("Lactometer" signifies the last two figures of the specific gravity reading, usually about 32; i.e., specific gravity = 1.032.) If the figure for solids not fat be less than 8 per cent, water dilution is suspected; if less than 7.7 per cent, water dilution is almost certain.

The determination of adulteration with cow's milk has been approached by several methods as considered in Human Milk Technology. The most satisfactory one of these requires preparation of serum from rabbits immunized by three intravenous injections of cow's milk in amounts of 5 c.c. on alternate days. (Rabbit serum so prepared may be obtained in capillary tubes from the Directory of Mothers' Milk, Inc., Boston, Mass.) A drop of serum is mixed on a glass slide with a drop of the milk to be tested; the formation of a precipitate in the resulting mixture, observed against a dark background, indicates the presence of cow's milk in the drop tested. This reaction will not detect the presence of milk from some other species, such as the goat, although of course a serum for that purpose could be made.

The adulteration of breast milk with cow's milk, if practiced for economic gain by a woman selling her milk, might well be detected or at least suspected from the bacteria count in the adulterated portions. It would be difficult to dilute with cow's milk without raising the bacterial count at the same time, unless such an expensive grade of milk was used for the adulterant that the fraud would not be economically worth attempting.

H. Distribution.—The method of preparation of orders for distribution will vary with the distance and risk in shipment. In every instance, pasteurized liquid milk should be tightly sealed, properly labeled, and packed in sufficient ice to keep the milk chilled until it reaches its destination.

Frozen milk in glass jars must be well wrapped to prevent breakage and must be packed in sufficient dry ice to prevent the milk from liquefying before it reaches its destination.

Express delivery service should be arranged for all shipments.

Airplane service is recommended where possible.

Orders should be plainly addressed in indelible pencil or crayon with complete instruction to Baggage Master as to:

Name of patient
Address
Train number
Train leaving time and whether Standard Time or Daylight Saving Time
Express collect

Amount of insurance

Shipping containers should be zinc lined and marked "Perishable," and "Fragile," and "Rush."

VIII. Records and Reports

Records are important not only for the efficient administration of a Milk Bureau, but also because statistical reports made from these records are of value in gaining community interest.

In Appendices 1 to 7 are samples of records which have been found to be practical. These records are:

1. Records of physical examination of milk donor.
2. Health record and weight chart of the donor's baby.
3. Social history of donor.
4. Health and social record of the baby receiving the milk.
5. Daily record of the donor.
6. {Monthly statistical reports from which yearly
7. {statistics may be compiled.

1940-1941

ALEXANDER T. MARTIN, M.D., Chairman
JULIUS HESS, M.D.
CARL H. LAWS, M.D.
E. EARL MOODY, M.D.
WILLIAM ORR, M.D.

1941-1942

CLEMENT A. SMITH, M.D., Chairman
JULIUS HESS, M.D.
CARL H. LAWS, M.D.
E. EARL MOODY, M.D.
WILLIAM ORR, M.D.
ARTHUR G. QUINN, M.D.

Appendix 1

PHYSICAL EXAMINATION OF MILK DONOR

Date _____

Name _____ Age _____

Address _____

SKIN: _____

THROAT: _____

TEETH: _____

BREASTS: _____

HEART: B. P. _____

LUNGS: _____

CHEST X-RAY: _____

SPUTUM SPECIMEN: _____

NOSE AND THROAT CULTURES: _____

WASSERMANN: _____

URINALYSIS: _____

M.D.

HEALTH OFFICER

Appendix 2

HEALTH RECORD AND WEIGHT CHART OF DONOR'S BABY

Name _____ Date of birth _____

Midwife

Delivered by Doctor _____ Where _____

Under health supervision of _____

Date	Weight	Date	Weight
Birth			
		Remarks	

Appendix 3

SOCIAL HISTORY OF DONOR

Name _____ Age _____ Para _____

Address _____ Race _____

Referred by _____ Religion _____

Date—from _____ to _____ Total Period _____

HOME INVESTIGATION

Family Income _____ Rental _____

No. in household _____ No. of rooms _____ Sanitation _____

Ventilation and lighting _____ Refrigeration _____

Organization of household _____

FAMILY GROUP

Name	Age	Health	Occupation or School
Husband			

Follow-up

Appendix 4

HEALTH AND SOCIAL RECORD OF BABY RECEIVING MILK

(Front)

Baby's Name — Date of Birth

Address — Dept. in Hospital

Diagnosis

Weights: Birth Present Dismissal

Doctor

Address — Tel. No.

Father's Name — Tel. No.

Home Address — Apt. No.

Date Ordered — Date Discontinued

Reason for Disc. Order

No. Ounces daily — Total No. of —— ozs. over a period of —— days

Weight Gain — Weight Loss

Payment: — Referred by:

Full — Hospital

Part — Doctor

Free — Friend

(Back)

SOCIAL HISTORY

(used when reduced rate is requested)

Employer — Tel. No.

Address

Income *Rent* *Other Expenditures*

Salary

Other

Remarks:

Appendix 5

MOTHERS' MILK BUREAU

DAILY RECORD

Day _____

Date _____

ON HAND _____ OZS.

NO.	NAME	A. M.	P. M.
1			
2			
3			
4			
5			
6			

Collections:
A. M. _____ Ozs.

P. M. _____ Ozs.

Deposits Total _____ Ozs.

Refunds

Milk Frozen

_____ Ozs.

Milk Canned

_____ Ozs.

Used:
Frozen Milk _____ Ozs.

Canned Milk _____ Ozs.

Cash $_____

Appendix 6

MOTHERS' MILK BUREAU

MOTHERS' MILK COLLECTED AND DISTRIBUTED

(Date)

Collections

On hand (date)_____Ozs.

Fresh

Frozen

Canned

Total_____Ozs.

Collected from:

Donors:_____Ozs.

_____

_____

Distributions

Sold:

Hospital
(List below)

Private patients
Total ounces sold
Analysis
Lost in transportation
Total ozs. for (month)
Balance on hand (date)

Total Ozs. _____

_____

Frozen Milk

Balance on hand (date)
Frozen during (month)

Used during (month)
Balance on hand (date)

Canned Milk

Balance on hand (date)
Canned

Used during (month)
Balance on hand (date)

MILK ON HAND (date)

Fresh milk

Frozen milk_____

Total

Research canned milk

REPORT ON MOTHERS

Mothers carried (date)
Mothers admitted during (month)

Total

Mothers carried (date)
Mothers discharged during (month)

Total

Appendix 7

MOTHER'S MILK BUREAU

BABIES' REPORT

(Date)

Babies carried (date)
Babies admitted during (month)

Babies discharged during (month)

Formula

Own Mothers' Milk

Transferred

Expired

Babies carried (date)

Total Case Load

	Prem.	Term	Total
Babies discharged during (month)			
Babies carried into (month)			
Babies expired during (month)			
Total Case Load			

BABIES EXPIRED DURING (MONTH)

Hospital	Name	Diagnosis	Age when Ordered	No. of days on Mother's Milk
(List here)				

DOCTORS USING SERVICE

	Old	*New*

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News and Notes

Written examinations for candidates appearing before the American Board of Pediatrics will be held on Oct. 8, 1943. Instructions to candidates for the examination will be issued from the office of the secretary in due time.

Oral examinations will be conducted by the Board in New York City on Nov. 20-21, 1943, and in Cincinnati, Ohio, on Dec. 11, 1943.

Book Reviews

Nasal Medication, A Practical Guide. Noah D. Fabricant, M.D., M.S., Baltimore, 1942, The Williams and Wilkins Co., 122 pages. Price, $2.50.

This book aims to orient the general practitioner and pediatrician with respect to nasal medication. Two thoughts have been kept in mind in its preparation: one, to have it serve as a practical guide for physicians; and the other, to have it prove a reference for those who employ nasal medication. Special stress has been placed on physiology and histopathology because these subjects provide to a great extent the quintessence of rational and intelligent nasal medication.

Most of the statements found in these pages undoubtedly will be generally accepted by authorities, while others, still within the realm of experimentation and controversy, are included purposely to give the reader some knowledge of disputed topics. The author has not included the complete list of the various types of nasal medication available nor is there a detailed description of pharmacologic action of nasal preparations.

There is a discussion of the anatomy of the nasal cavity and the nasal sinuses; the histology, histopathology, and physiology of the nasal and sinus mucous membrane; the effect of drugs on ciliary action and on the nasal mucous membrane; methods of applying nasal medication; nasal medication in disease; and finally a brief but highly important chapter on nasal medication in children. Each chapter includes a good list of references to recent literature, although most of the references in the chapter on nasal medication in children are from the rhinologic literature. More than the usual amount of space in the text is given to indirect quotation and presentation of literature from other sources; so much so that one may feel that the author's own work is obscured. This, however, is done skillfully, and the final effect is one of a completed picture of the subject.

It is to be regretted that so little space is given to nasal medication in children since the author is careful to include pediatricians as an important group in his audience. Much of the discussion in the early chapters on pathology and physiology would, of course, be applicable to children as well. The book is well written, tells an interesting story, and should serve as a real guide in a field where nearly everyone is his own master and, most, the victims of advertising and persuasion of commercial products, even the atrocious statements over the radio. The poor noses of our patients will welcome such intelligent discussion. It should be every pediatrician's duty to see that the information is properly transmitted to those noses.

McCULLOCH.

Children's Behavior Problems. Vol. II. Relative Importance and Interrelations Among Traits. Luton Ackerson, University of Chicago Press, 1942, Chicago, 570 pages. Price, $5.

A statistical study based on the case records of the Illinois Institute for Juvenile Research. Volume I, which considered genetic and intellectual factors, was published in 1931. Volume II reports a study of the intercorrelation of certain behavior traits chosen because of their frequency of occurrence in the case records of the Institute. The monograph, because of its nature, is of more interest to the child psychologist than to the pediatrician.

Synopsis of Diseases of the Skin, Richard L. Sutton, M.D., and Richard L. Sutton, Jr., M.D., The C. V. Mosby Company, St. Louis, 1942, 481 pages with 413 illustrations. Price, $5.50.

A handy desk manual on skin diseases. The material is arranged in the usual textbook manner. The text is good and the illustrations excellent. The book is of particular value to the practitioner of pediatrics for quick reference to the causes and treatment of the more unusual skin conditions which are occasionally encountered.

Child Behavior and Development. Edited by Roger Baker, James S. Kounin, and Herbert F. Wright, McGraw-Hill Book Co., Inc., New York, 1943, 652 pages. Price, $4.

The volume aims to provide material for work in child psychology. The editors have selected twenty-five studies suggested by fifty-two members of the Society for Research in Child Development. The studies have been abstracted or adapted from studies by the leaders in child psychology. The material selected covers a very wide field and includes such subjects as development of the newborn and young infant, twins, gifted children, intelligence measurements, children's fears, play social behavior, adolescent personality, etc. Although the volume is intended for college students, it can be read with great profit by the pediatrician as it will give him the background of much research and the methods of research being done by the child psychologist. The selection of material is excellent.